FINAL

Level II Screening Ecological Risk Assessment Portland Shipyard, Operable Unit 2 Swan Island Upland Facility

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Prepared for:

Ash Creek Associates
3015 SW First Avenue
Portland, OR 97201

On Behalf of:

Port of Portland
121 NW Everett
Portland, OR 97209

Prepared by:

FORMATION ENVIRONMENTAL
2500 55th Street, Suite 200
Boulder, Colorado 80301

TABLE OF CONTENTS

Page

LIST OF TABLES iii
LIST OF FIGURES iii
LIST OF APPENDICES iii
LIST OF ACRONYMS AND ABBREVIATIONS v
1.0 INTRODUCTION 1
1.1 Purpose and Scope 1
1.2 Facility Location, Description and History 2
1.3 Current and Future Site Uses 3
1.4 Summary of Investigations 3
1.5 Summary of Level I Scoping ERA 4
1.6 Document Organization 5
2.0 ECOLOGICAL SITE DESCRIPTION 6
2.1 Site Description and Site-Specific Ecological Receptors 6
2.1.1 Threatened and Endangered Species 7
2.2 Observed Impacts 7
2.3 Other Ecologically Important Species/Habitats 8
3.0 LEVEL II SCREENING ANALYSIS 9
3.1 Methods for Level II Screening 9
3.1.1 Data Available for Screening 9
3.1.2 Candidate Assessment Endpoints 11
3.1.3 Calculating COI Concentrations 11
3.1.4 Frequency of Detection and Background Analysis 12
3.1.5 Comparisons to Screening Level Values (SLVs) 12
3.2 Level II Screening Results and Identification of Contaminants of Potential Ecological Concern (CPECs) 13
3.2.1 Frequency of Detection and Background Analysis 14
3.2.2 Screening Analysis 14
4.0 EXPANDED LEVEL II ASSESSMENT 17
4.1 Expanded Level II Assessment – Plants/Invertebrates 17
4.2 Expanded Level II Assessment - Birds 18
4.2.1 Representative Bird Receptor 18
4.2.2 Exposure Estimation Methodology 19
4.2.3 Ecological Benchmark Values (EBVs) 20
4.2.4 Expanded Level II Analysis Results - Birds 20
5.0 POPULATION-LEVEL PROBABILISTIC EVALUATION 22
5.1 Population-Level Exposure Analysis and Risk Estimation Methodology 22
5.2 Population-Level Probabilistic Analysis Results 24

6.0 ECOLOGICAL RISK ASSESSMENT CONCLUSIONS 27
6.1 Overall Level II ERA Conclusions 27
6.2 Technical-Management Decision Points (TMDPs) 27
6.2.1 TMDP 3 28
6.2.2 TMDP 4 28
7.0 REFERENCES 30

LIST OF TABLES

Table	Title
3-1	Level II Screening Level Summary Table
3-2	Summary of CPECs – Riverbank Soils
4-1	Approach for Calculation of Estimated CPEC Intake for Modeled Receptor - American Robin
4-2	Ecological Benchmark Values (EBVs)
4-3	Exposure Calculation and Comparison to EBVs
5-1	Summary Table for Population-level Probabilistic Risk Analyses

LIST OF FIGURES

Figure	Title
1-1	Swan Island Upland Facility OU2, Site Overview
4-1	Swan Island Upland Facility OU2, Plant and Invertebrate Screening Level Exceedances - Zinc
4-2	Swan Island Upland Facility OU2, Plant and Invertebrate Screening Level Exceedances – Copper

LIST OF APPENDICES

Appendix	Title
A	Level I Scoping Ecological Risk Assessment, Swan Island Upland Facility, Operable Unit 2 (February 2006), with Subsequent Letters and Attachments
B	Riverbank and Substation A Surface Soil Results
C-1	Riverbank Soil Summary and Risk Screening, Plants
C-2	Riverbank Soil Summary and Risk Screening, Invertebrates
C-3	Riverbank Soil Summary and Risk Screening, Birds
C-4	Riverbank Soil Summary and Risk Screening, Mammals

D-1	Riverbank Soil Summary with 90UCLs and Risk Screening, Wildlife Receptors
D-2	Riverbank Soil 90UCL Calculations - ProUCL Output
E	Substation A Soil Summary and Risk Screening, All Ecological Receptors
F-1	Calculation Worksheets for Population-level Probabilistic Risk Analyses - Zinc (discrete samples)
F-2	Calculation Worksheets for Population-level Probabilistic Risk Analyses - Zinc (composite samples)
F-3	Calculation Worksheets for Population-level Probabilistic Risk Analyses - Lead (discrete samples)
F-4	Calculation Worksheets for Population-level Probabilistic Risk Analyses - Lead (composite samples)
F-5	Calculation Worksheets for Population-level Probabilistic Risk Analyses - Copper (discrete samples)
F-6	Calculation Worksheets for Population-level Probabilistic Risk Analyses - Copper (composite samples)
G-1	Ecological Benchmark Value (EBV) Calculations based on Reproduction/ Growth Endpoints-Zinc
G-2	Ecological Benchmark Value (EBV) Calculations based on a Mortality Endpoint-Zinc
G-3	Ecological Benchmark Value (EBV) Calculations based on Reproduction/ Growth Endpoints-Lead
G-4	Ecological Benchmark Value (EBV) Calculations based on a Mortality Endpoint-Lead
G-5	Ecological Benchmark Value (EBV) Calculations based on Reproduction/ Growth Endpoints-Copper
G-6	Ecological Benchmark Value (EBV) Calculations based on a Mortality Endpoint-Copper

LIST OF ACRONYMS AND ABBREVIATIONS

1x-	One time
5x-	Five times
%	Percent
90UCL	90^{th} percentile Upper Confidence Limit
ACA	Ash Creek Associates
ARL	Acceptable Risk Level
bgs	Below Ground Surface
BW	Body Weight
CA	Contaminated Area
COIs	Contaminants of Interest
COPC	Chemicals of Potential Concern
CPECs	Contaminants of Potential Ecological Concern
CSM	Conceptual Site Model
DEQ	Department of Environmental Quality
EBV	Ecological Benchmark Value
Eco-SSL	Ecological Soil Screening Level
ECSI	Environmental Cleanup Site Information
EPCs	Exposure Point Concentrations
GIS	Geographic Information System
ERA	Ecological Risk Assessment
HHRA	Human Health Risk Assessment
HPAHs	High Molecular Weight Polycyclic Aromatic Hydrocarbons
HR	Home Range
LC50	Median Lethal Concentration
LD50	Median Lethal Dose
LOAEL	Lowest Observed Adverse Effects Level
LPAHs	Low Molecular Weight Polycyclic Aromatic Hydrocarbons
LWG	Lower Willamette Group
MDCs	Maximum Detected Concentrations
MTCA	Model Toxics Control Act
mg/kg	Milligram per kilogram
NOAEL	No-observed-adverse-effects level
OAR	Oregon Administrative Rule
OBP	Oregon Bureau of Planning
OHW	Ordinary High Water Line
ONHP	Oregon Biodiversity Information Center
ORNL	Oak Ridge National Laboratory
OU	Operable Unit
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
Q	Receptor Designator
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
SCE	Source Control Evaluation
SIUF	Swan Island Upland Facility
SLVs	Screening Level Values
T	Toxicity Ratio

TBT	Tri-n-butylin
T/E	Threatened and Endangered
TMDP	Technical-Management Decision Point
TQ	Toxicity Quotient
USEPA	Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VCP	Voluntary Cleanup Program
VOCs	Volatile Organic Compounds
WDOE	Washington Department of Ecology

1.0 INTRODUCTION

This document presents the Level II Screening Ecological Risk Assessment (ERA) for the Swan Island Upland Facility (SIUF) (ECSI Site No. 271) Operable Unit 2 (OU2), Portland, Oregon. The ERA is being performed as part of a Voluntary Agreement for Remedial Investigation, Source Control Measures, and Feasibility Study for the SIUF between the Port of Portland (Port) and Oregon Department of Environmental Quality (DEQ), dated July 24, 2006.

1.1 Purpose and Scope

A draft Level I Scoping ERA was prepared and submitted to DEQ in February 2006 (NewFields 2006). Based on the results of the Level I analysis, it was determined that a Level II Screening ERA was warranted for potential exposure of ecological receptors to riverbank soils. Additional riverbank soil sampling occurred in 2010 to support the risk evaluation and the Source Control Evaluation (SCE) at the facility (Ash Creek Associates [ACA] 2010). A draft Level II ERA based upon the process prescribed by DEQ in the *Guidance for Ecological Risk Assessment: Levels I, II, III, IV* (DEQ 1998 with updates through 2001) was submitted to DEQ in April 2010 (Formation Environmental [Formation] 2010). Comments on the source control document were received from DEQ on August 9, 2010. At the request of DEQ, the Port conducted additional riverbank soil and surface soil sampling at a historical substation and in areas of visible erosion that were identified during site reconnaissance. Sampling summary letter reports and a SCE addendum were provided to DEQ in 2011 (ACA 2011a, 2011b, 2011c). Comments on the draft Level II Screening ERA were discussed with DEQ during a conference call on June 6, 2012 (DEQ 2012). This draft report presents the Level II risk assessment as described in DEQ guidance. Consistent with DEQ discussions in June 2012, the report also includes an expanded Level II exposure and risk analysis and population-level probabilistic analyses for OU2.

The DEQ guidance describes a sequence for conducting ERAs, beginning with Level I Scoping. The purpose of the Level I ERA is to provide a conservative qualitative determination of whether there is reason to believe that ecological receptors and/or exposure pathways are present at OU2. If existing information indicates that site conditions will not result in exposure of ecological receptors, then no further risk analysis is necessary. If hazardous substances and exposure pathways are present, the process proceeds to a Level II Screening analysis to determine if hazardous substances are present at potentially ecotoxic concentrations and, if so, what additional risk analysis may be necessary to make risk management decisions for a facility. This document also presents an expanded Level II analysis and supplemental population-level probabilistic risk evaluations to help support risk management decisions.

In accordance with the Voluntary Agreement, the scope of the Level II ERA at OU2 is limited to the upland areas above the ordinary high water (OHW) mark of the Willamette River.

1.2 Facility Location, Description and History

For the purpose of this ERA, the "Facility" consists of OU2, which is part of the SIUF. The SIUF was previously referred to by DEQ as the "Swan Island Portland Ship Yard" and identified by DEQ as Environmental Cleanup Site Information (ECSI) Site 271. OU2 was created as an accommodation to the Port's desire to lease all or some of the property concerned to a new tenant. Figure 1-1 shows the location of the SIUF and the boundary of OU2. OU2 consists of approximately 24 acres of upland property at the SIUF and is owned by the Port. Prior to 2008, OU2 also included the paved parking area now designated as Operable Unit 4 (OU4). Specific details of site history are discussed in the Draft Supplemental Preliminary Assessment (ACA 2006) and RI/FS work plan (Bridgewater 2000).

The Port acquired Swan Island in 1922. At that time, the main channel of the river was on the easterly side of the island, between the island and what is now Mocks Landing. Following the purchase, the navigation channel was relocated to the west side of the island. Shore areas on the island were excavated to form a new and wider channel to the southwest. The island's surface elevation was raised with fill from excavation and dredging activities. A causeway was constructed to the southeast to connect the island to the shore, which created Swan Island Lagoon. Swan Island was then developed and served as the municipal airport for Portland from 1931 until it was relocated to Portland International Airport in 1940. The airport was used by private aviation tenants until 1942.

In 1942, the U.S. Maritime Commission entered into an agreement to lease approximately 250 acres of Swan Island from the Port. The Maritime Commission then contracted with Kaiser Company for the construction and operation of a shipbuilding yard on the island. Kaiser operated the shipyard until 1945. From 1945 until 1949, the shipyard was sub-leased by the United States to various tenants. In 1949, the Port purchased the shipyard assets from the United States and subsequently managed the shipyard as a multi-user facility until 1996. In 1996, all shipyard management activities were assumed by Cascade General. The Port sold the shipyard to Cascade General in 2000.

OU2 has been used for relatively low-impact industrial activities throughout its history. A paved runway was present on OU2 during the period of operation of the municipal airport on Swan Island (1931 until 1942). From the 1940s to 1978, OU2 was primarily open land with railroad spurs used for materials receiving and storage. In 1978, the area was used to stage pre-cast concrete structures for construction of the ballast water treatment plant at Operable Unit 1 (OU1). From 1985 until 1990, OU2 was used by the Atlantic Richfield Company to construct modular units for oil processing on Alaska's North Slope. After 1990, OU2 was used for materials and equipment storage in support of ship repair activities; sand, gravel, and rock storage; for a concrete batch plant; for storage and assembly of pieces of the Freemont Bridge; and for truck and trailer parking.

1.3 Current and Future Site Uses

Currently, a portion of OU2 is leased to Daimler Trucks North American LLC (DTNA) for temporary staging of trucks and trailers, and a portion is leased to CEMEX for a concrete batch plant. The remainder of OU2 is vacant. The DTNA Leasehold covers approximately 7 acres at the southeast end of OU2. The CEMEX Leasehold includes approximately 12.1 acres in the central portion of OU2. Vacant areas include 2.7 acres of land along Berth 315 and the strip of land (2.2 acres) between the DTNA/CEMEX Leaseholds and the OHW.

The current and reasonably likely future land use for OU2 and the SIUF is industrial. The SIUF is currently zoned industrial and lies within the City of Portland Industrial Sanctuary and Swan Island Plan District. The SIUF is expected to continue to be used for industrial purposes, consistent with goals and policies stated in the City's Comprehensive Plan (Oregon Bureau of Planning (OBP) 2006).

OU2 is surrounded by similarly developed tracts and no significant upland ecological resources are present within 1 mile of OU2. No change in land use conformation is anticipated for the foreseeable future.

1.4 Summary of Investigations

A Baseline Human Health Risk Assessment (HHRA) (ACA 2009a) was completed in September 2009. The HHRA provided a comprehensive summary of the multiple investigations conducted between 2000 and 2008 to support the RI and risk assessment efforts, as well as sampling performed on OU2 prior to the RI in 1998.

The following RI data collection activities and related reports at the OU2 Facility include the following:

- Remedial Investigation/Feasibility Study Work Plan for the Portland Shipyard (Bridgewater 2000);
- Phase IB Work Plan Addendum, Portland Shipyard Remedial Investigation (Bridgewater 2001);
- Phase IB and II Soil and Groundwater Sampling Results, Portland Shipyard Remedial Investigation (Bridgewater 2002);
- Operable Unit 2, Removal Action Report, Swan Island Upland Facility (Bridgewater 2006);
- Former Substation and Berth 305 Sampling Results Addendum, Swan Island Upland Facility (ACA 2007b);
- Swan Island Upland Facility, Operable Unit 2 Supplemental Sampling Results (Port 2007a);
- Memorandum: Storm Water Piping Removal Oversight (ACA 2007a);

- Memorandum: Outfalls, Swan Island Upland Facility – Operable Unit 2 (ACA 2008);
- OU2 Riverbank Soil Sampling and Pipe Abandonment, Swan Island Upland Facility (ACA 2009b);
- Swan Island Upland Facility, Operable Unit 2, Supplemental Groundwater Sampling Results (Port 2007b);
- 2007 Annual Groundwater Monitoring Results, Swan Island Upland Facility, Remedial Investigation (Bridgewater 2008);
- Source Control Evaluation, Operable Unit 2, Swan Island Upland Facility (ACA 2010);
- OU2 Riverbank Soil Sampling, Swan Island Upland Facility (ACA 2011a);
- OU2 Surface Soil Sampling, Swan Island Upland Facility (ACA 2011b);
- Source Control Evaluation (SCE) Addendum, Operable Unit 2, Swan Island Upland Facility (ACA 2011c).

The data collected before 2006 were incorporated into the Level I ERA and the additional data collected since 2006 are considered in this Level II ERA.

1.5 Summary of Level I Scoping ERA

A draft Level I Scoping ERA was prepared and submitted to DEQ in February 2006 (NewFields 2006) and is included in Appendix A. In addition, a March 2006 DEQ comment letter (DEQ 2006a) was responded to in a July 2006 Port letter (Port 2006). The letters (and attachments) are also included in Appendix A.

The Level I evaluation concluded that there are limited ecological resources present in the upland areas at OU2. The upland area is either devoid of vegetation in work/paved areas or contains sparse ruderal vegetation. Wildlife is unlikely to feed in these portions of OU2 and ecological exposures would be limited to intermittent and transient presence. There does not appear to be complete exposure pathways for terrestrial plant and animal populations in the upland portion of OU2.

The vegetated riverbank areas may be habitat for small birds and small mammals, and may be visited by other species in transit. Except for the three locations where drain pipes were installed for ARCO, upland areas have not drained to the riverbank. These pipes were capped when ARCO ceased its operations in 1990, and the Port removed the pipes in 2006 (ACA 2007a). Therefore, exposure of ecological receptors to site-specific contaminants on the riverbank or shoreline areas is unlikely. However, because complete exposure pathways are possible in the riverbank areas, it was determined by DEQ that a Level II screening analysis would be necessary.

Overall, based on the Level I ERA, it was determined that potential exposure pathways exist for ecological receptors that could contact contaminants of interest (COIs) in surface soils in riverbank areas as a result of potential transport from pipelines discharging on the riverbank. Potential ecological receptors evaluated in the Level II evaluation are plants and invertebrates in the riverbank area and small birds and mammals that may visit that area.

1.6 Document Organization

Section 2 includes the description of ecological site conditions. Section 3 presents the methodology and results of the Level II Screening analysis, including identification of contaminants of potential ecological concern (CPECs) and a preliminary conceptual site model (CSM). Section 4 outlines the methodology and results of an expanded Level II analysis. Section 5 presents supplemental population-level probabilistic risk evaluation methodology and results. Technical Management Decision Points (TMDPs) and overall conclusions are summarized in Section 6. References are provided in Section 7.

2.0 ECOLOGICAL SITE DESCRIPTION

A Facility visit was conducted by the project lead ecological risk assessor on October 31, 2005. The Level I Scoping ERA (NewFields 2006) presented an ecological site description based on an OU2 visit, aerial photographs, and general Facility knowledge. Site conditions have not changed appreciably since that time, and the ecological site description is presented below. Refer to the Level I Scoping evaluation in Appendix A for photographs from site visits.

2.1 Site Description and Site-Specific Ecological Receptors

The portions of OU2 that are northeast (i.e., inland) of the Willamette River bank are largely devoid of vegetation and are generally composed of asphalt-covered parking lot or gravel-covered work areas with concrete slabs. Vegetation on most of the property is strictly ruderal, with sparse vegetation consisting of opportunistic or weedy annual species, but more commonly containing no vegetation at all (Figure 1-1). The surface soil conditions and use in these areas prevent more long-lived plant species from establishing and creating an early successional native habitat type. The unpaved portions of OU2 do not, and will not, provide suitable habitat for ecological receptors because of former, current, and reasonably likely future uses of the property (i.e., truck and trailer parking and aggregate processing).

The riverbank and beach conditions at OU2 are summarized below but are described fully in the SCE and SCE addendum (ACA 2010, 2011c). A visual reconnaissance of the OU2 riverbank was completed in 2010 to identify geomorphic features, vegetation, and structures. The riverbank at OU2 is composed of fill material with rock, concrete debris and rip-rap. The surface condition of the riverbank is characterized by dense vegetation above the approximate OHW. Below the OHW, the bank generally consists of rip rap with occasional sandy beaches. The visual reconnaissance in 2010 identified 17 surface features along the riverbank, including six structures (3 outfalls, 1 historical substation platform, 1 manway, and 1 aggregate conveyor), two areas of historical bank disturbance that are now densely vegetated, three areas of bare ground, and six visible erosion scarps. The erosion scarps are linear features running parallel to the riverbank that are located at or above the transition from rip rap to vegetated riverbank. Other than these features, the riverbank area is densely vegetated with ground cover of grasses and shrubs, including introduced species such as Himalayan blackberry. A variety of willow species (e.g., Pacific, Columbia River, and Piper’s Willow) and black cottonwood saplings have become established on the beach. The vegetated area on the river bank (approximately 3-5 acres) is narrow (approximately 45-80 feet wide) and is disconnected from riparian upland areas.

Riverbank sampling locations in the Level II assessment include samples collected between OHW and the ordinary low water line (OLWL). This is based on direction from DEQ to: (1) sample these locations; and (2) to use these data in the Level II characterization (DEQ 2006a & April 20, 2006 meeting as cited in DEQ 2006b).

During the site visit, no receptors other than waterfowl and other birds associated with the river were observed at OU2. However, it is possible that songbirds may utilize the shrub areas during other parts of the year.

The Willamette River near OU2 provides habitat for aquatic and semi-aquatic species. The river is identified as a sensitive environment in Oregon Administrative Rule (OAR) 340-122-0115. There are no wetlands or permanent water bodies on OU2.

During the Portland Harbor RI/FS, the Lower Willamette Group (LWG) collected crayfish, largescale sucker, sculpin, peamouth, and small mouth bass within one mile of OU2, but no biota sampling was attempted near the shore of OU2. The LWG collected sediment samples offshore of OU2 and a beach sediment sample from the beaches adjacent to OU2. The resulting data is being used in the Portland Harbor RI/FS process, but are not used in this report since these sampling locations are not in OU2.

2.1.1 Threatened and Endangered Species

A listing of threatened and endangered (T/E) species potentially present within a two-mile radius of OU2 was provided by the Oregon Biodiversity Information Center (OBIC). The list includes historical presence of federal and state-listed T/E species. The Level I ERA in Appendix A summarizes the species listed by the OBIC. A copy of the letter from the ONHP identifying the species is also included in Appendix A.

Yellow-billed cuckoo is identified as a candidate T/E species in the vicinity. In the ONHP records, the last known observation of the yellow-billed cuckoo is along the Columbia River in 1985. According to the U.S. Fish and Wildlife Service (USFWS) species profile (USFWS 2010), Oregon counties in which the yellow-billed cuckoo is currently known to occur include: Harney, Deschutes, and Malheur. It is not listed as currently occurring in Multnomah County. Thus, no federally-listed T/E upland wildlife species are assumed to occur at OU2.

2.2 Observed Impacts

Ecological resources (habitat or food sources) are extremely limited within OU2, restricted to the narrow riverbank area. No ecotoxicological impacts on ecological receptors were observed at OU2.

2.3 Other Ecologically Important Species/Habitats

Based on the Facility visit, historical information, ONHP data, and general Facility knowledge, there are no rare or ecologically unusual habitats or species at the Facility.

3.0 LEVEL II SCREENING ANALYSIS

3.1 Methods for Level II Screening

The ecotoxicological risk screen was conducted according to DEQ guidance for Level II Screening ERA (DEQ 2001), with additional modifications based on discussion with DEQ (DEQ 2012). DEQ guidance specifies several tasks when the Level II analysis is conducted independently. However, many of the tasks and much of the background information cited in the Level II guidance were addressed in the Level I evaluation (i.e., conduct site survey, provide site description, identify ecological receptors, and identify complete exposure pathways) and are summarized in the previous section. Therefore, the analysis presented below focuses on the tasks that relate directly to conducting the Level II screen, including:

- evaluate data sufficiency (Task 1 of the guidance);
- identify candidate assessment endpoints (Task 6);
- identify known ecological effects (Task 7);
- calculate COI concentrations (Task 8);
- identify contaminants of potential ecological concern (CPECs) (Task 9); and
- develop preliminary conceptual site model (CSM) (Task 10).

Expanded Level II and supplemental population-level probabilistic analyses were performed to support this ERA and those analyses are discussed further in Sections 5.0 and 6.0.

3.1.1 Data Available for Screening

There has been considerable sampling to support the RI; refer to Section 1.4 (Summary of Investigations). As summarized in the HHRA for the Facility (ACA 2009a), the RI for the Facility included chemical analysis of up to 97 soil samples and 14 groundwater samples. Additionally, 47 soil samples were later collected in 2006, 2008, and 2011 to support the SCE and SCE addendum (ACA 2010, 2011c). These data are of sufficient quality for use in a risk assessment.

This Level II ERA focuses specifically on surface soil data collected from the riverbank area. Riverbank sampling locations are shown on Figure 1-1 and include: PS-S-01-01/Boring 1 (discrete sample), RB-1 through RB-7 (3 discrete samples and 1 composite sample at each location), and RB-8 through RB-15 (2 discrete samples at each location), and historical Substation A (2 composite samples).

Refer to ACA (2010, 2011a, 2011b) for a description river bank sampling. PS-S-01-01/Boring 1 was collected as a discrete sample. The sampling at RB-1 through RB-7 locations consisted of three discrete samples down the riverbank at each location and one composite sample combined from the discrete samples. The sampling at RB-8 through RB-15 locations consisted of two discrete samples along the riverbank feature at each location (e.g., one on top of the erosion scarp at this point on the riverbank, and one downslope on the face of the erosion scarp). At historical Substation A, two composite samples were created from 4 discrete samples within and 4 discrete samples downslope from the footprint of the feature (the discrete samples were not submitted for analysis). Because this historical substation area was the target of focused sampling, data from this area were evaluated separately throughout this assessment.

Refer to Appendix B of this document for analytical results from all riverbank area surface soil samples. Appendices C and E of this document provide a summary of soil sample results, including the depth range of collected samples, detection frequency, minimum and maximum non-detected and detected concentrations for the riverbank (Appendix C) and historical Substation A (Appendix E).

As identified in the HHRA, the COIs include petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), phthalates, tri-n-butyltin (TBT) and metals. Although volatile organic compounds (VOCs) were evaluated as COIs in the HHRA based on presence in groundwater, only two VOCs were identified as chemicals of potential concern (COPCs) in water (vinyl chloride and chloroform), and neither of those were detected in soil. Based on the lack of VOC detections in soil, and a lack of a complete exposure pathway for ecological receptors to encounter VOCs in surface soils of the riverbank, VOCs will not be considered as COIs in this Level II Screening ERA.

Riverbank and Substation A samples were analyzed for a range of COIs including petroleum hydrocarbons, PAHs, PCBs (Aroclors), phthalates, butyltins, and metals (Appendix B). The following list identifies which locations were analyzed for each group of COIs:

- **Petroleum hydrocarbons:** PS-S-01-01/Boring 1 (discrete), RB-1 through RB-7 (composites), Substation A (composites);
- **PAHs:** RB-1 through RB-3 (composites and discretes), RB-4 through RB-7 (composites), RB-8 through RB-15 (discretes);
- **PCBs (Aroclors):** PS-S-01-01/Boring 1 (discrete), RB-1 through RB-7 (composites), RB-8 through RB-15 (discretes), Substation A (composites);
- **Phthalates:** RB-4 through RB-6 (composites);
- **Butyltins:** RB-8 (discretes), RB-10 (discretes), RB-13 (discretes), RB-11 (discretes), RB-4 through RB-6 (composites and discretes; TBT only);
- **Metals:** PS-S-01-01/Boring 1 (discrete), RB-1 through RB-7 (composites), RB-4 through RB-7 (discretes; lead only), RB-8 through RB-15 (discretes);

3.1.2 Candidate Assessment Endpoints

According to DEQ guidance (2001), assessment endpoints are "…an explicit expression of a value deemed important to protect, operationally defined by an entity (hereafter, "endpoint receptor") and one or more of that entity's measurable attributes…" Assessment endpoints serve to focus the ERA on species and measures that are directly relevant to risk management decisions for OU2. The assessment endpoints generally represent species or functional groups that are important to ecological function at a site, or rare species that have great ecological, aesthetic, or cultural value.

Assessment endpoints for a screening level assessment (e.g., Level II screening) are typically not as specific as those identified for baseline risk assessments where specific measures or data analysis methods are needed to make decisions. In addition, no T/E or other rare species are known to use the Facility. For the DEQ Level II analysis, screening level values (SLVs) for soils have been identified for general groups of organisms including plants, invertebrates, birds, and mammals. Therefore, the following candidate assessment endpoints were identified:

- Survival, growth, and reproduction of terrestrial plants;
- Survival, growth, and reproduction of terrestrial invertebrates;
- Survival, growth, and reproduction of terrestrial-feeding birds; and
- Survival, growth, and reproduction of terrestrial-feeding mammals.

3.1.3 Calculating COI Concentrations

Because wildlife receptors do not experience their environment on a "point" basis, environmental data for each COI need to be converted to an estimate of concentration over a habitat exposure area (DEQ 2001). Exposure-point concentrations (EPCs) are concentrations of COIs that represent a reasonable maximum exposure based on the media characteristics and site-specific receptors. The Level II guidance specifies that screening level EPCs can be based on (1) site maximum detected concentrations (MDCs) for immobile or nearly immobile receptors (i.e., plants and soil invertebrates), or (2) 90%-upper confidence limits (90UCL) of the mean concentrations for more mobile wildlife receptors (i.e., birds, mammals) (DEQ 2001).

EPCs of COIs for soil were calculated using data from riverbank locations to estimate reasonable maximum exposure for wildlife potentially visiting riverbank areas from adjacent locations. This approach assumes that wildlife receptors could utilize all areas of the riverbank; overall, riverbank habitat quality is considered low throughout. Soil samples with an upper depth less than 3 feet below ground surface (bgs) were included in the calculations, to adequately account for both surface soil exposure and exposure to potential burrowing animals.

For use in determining an EPC based on MDC, all available sample results (including composite samples and discrete samples) were included in the determination. The 90UCL-based EPCs were calculated separately for results from composite and discrete samples, and the results evaluated separately. This procedure prevents different kinds of samples from being combined in the 90UCL calculation. Results from the historical Substation A were not included in the 90UCL calculations, and instead evaluated independently from other riverbank samples.

The U.S. Environmental Protection Agency (USEPA) ProUCL computer program (USEPA 2010, 2011) was used to obtain data distribution evaluations and to calculate the 90UCLs for COIs that exceeded Level II bird and mammal screening criteria based on MDCs. In accordance with ProUCL guidance, each data set was first tested using the ProUCL software to determine the data distribution, and the appropriate 90UCL estimation method was chosen based on the best distribution fit and recommendations provided by ProUCL. In ProUCL, recommendations are provided for 95th percentile Upper Confidence Limit (95UCL) calculations only. 95UCL calculations were performed and these recommendations were applied to 90UCL evaluations. Appendix D presents output information from ProUCL 90UCL calculations, amended with notes regarding recommended values from 95UCL calculations. DEQ guidance (DEQ 2001) suggests that non-detects should be included with values of one-half their detection limits. However, the latest ProUCL package (version 4.1.01) includes computation methods (e.g., Kaplan-Meier) that can be used for datasets with non-detect values and so this methodology was used in 90UCL calculations.

3.1.4 Frequency of Detection and Background Analysis

COIs were screened on the basis of detection frequency and comparison to regional background levels before being compared to toxicity SLVs, as outlined in Task 9 of the Level II guidance (DEQ 2001). COIs detected in less than 5% of the samples were excluded as CPECs on the basis of infrequent detection (DEQ 2001). Because there were only 2 samples at historical Substation A, detection frequency was not incorporated into the screening evaluation for that sub-area. The MDCs for metals in soils were compared to regional background concentrations, as presented in the DEQ Toxicology Workgroup Memorandum (DEQ 2002) and summarized on Table 3-1. If the MDC for a COI was less than the background value, then the COI was excluded as a CPEC (DEQ 2001).

3.1.5 Comparisons to Screening Level Values (SLVs)

CPECs are identified by comparing COI concentrations to DEQ-approved Level II SLVs, and calculating the toxicity ratio (T) of the EPC (MDC or 90UCL) of each of the COIs to Level II approved SLVs (DEQ 2001). The guidance indicates two potential levels of analysis for soil COIs. For T/E species, the toxicity ratio is compared to the "receptor designator" (Q) value of 1 (i.e., if the riverbank soil concentration exceeds the approved SLV, the constituent is identified as a CPEC). For non-protected species, T is compared to a Q value of 5 (i.e., if the riverbank soil concentration exceeds five times [5x-] the SLV, the constituent is identified as a CPEC).

For completeness, both levels of results are presented. However, CPECs for OU2 are identified based on Q=5 because no T/E species are present or expected at the site. In addition, potential risk to a receptor from multiple COIs simultaneously within a given medium is addressed by comparing T of an individual COI to the sum of T for all COIs. If there is only one SLV available for COIs for a receptor, then it is not appropriate to calculate risk from multiple COIs.

If site concentrations are less than 5x-SLVs, no adverse effects are expected and no further analysis is required because risk is assumed to be negligible. It should be noted that the SLVs are based on intensive use of a site by receptors. Because OU2 is industrialized, and will remain so, ecological receptors are unlikely to utilize the site at levels represented in the SLVs. Therefore, concentrations that exceed the SLV do not necessarily represent unacceptable risk, but indicate that additional evaluation of site conditions may be necessary to support risk management decisions.

In June 2012 DEQ requested the use of SLVs different from those listed in the Level II Guidance (DEQ 2012). DEQ requested the following: 1) USEPA's Ecological Soil Screening Level (EcoSSL) values for metals, low molecular weight PAHs (LPAHs), and high molecular weight PAHs (HPAHs) (USEPA 2005a), 2) USEPA Region 5 Resource Conservation and Recovery Act (RCRA) screening levels for phthalates (USEPA 2001), 3) bioaccumulation-based screening levels from Washington State Department of Ecology (WDOE) Model Toxics Control Act (MTCA) (WDOE 2012) and Oak Ridge National Laboratory (ORNL) (Efroymson et al. 1997) sources for PCBs, and 4) WDOE MTCA screening levels for petroleum hydrocarbons (gasoline range organics, diesel range organics) (WDOE 2012).

Table 3-1 provides a summary of the SLVs and sources including: "Oregon DEQ Level II SLVs", "Oregon DEQ-Requested Alternative Screening Levels" (which outlines alternative values discussed above), and "Oregon DEQ-Approved Level II SLVs" (a summary of SLVs based first on DEQ-requested alternative values if available, and secondly on original DEQ Level II SLVs).

3.2 Level II Screening Results and Identification of Contaminants of Potential Ecological Concern (CPECs)

CPEC identification followed Task 9 of the DEQ guidance (DEQ 2001), including consideration of detection frequency, background comparison, cumulative risk from multiple COIs, bioaccumulative toxins, and availability of SLVs. Appendix C presents results of riverbank soil screening based on MDCs for plant, invertebrate, bird, and mammal receptors. For each COI, the tables show a detailed data summary, the MDC, SLVs, and results of the data comparison. Appendix D presents results of riverbank soil screening based on 90UCLs for bird and mammal receptors. Appendix E presents results of soil screening for the historical Substation A sub-area based on MDCs for plant, invertebrate, bird, and mammal receptors.

3.2.1 Frequency of Detection and Background Analysis

For riverbank soils at the Facility, MDCs of antimony, chromium, nickel, selenium, and silver were less than regional background concentrations and these analytes are excluded as CPECs (Appendix C), in accordance with Task 9 of DEQ guidance (DEQ 2001). It should be noted that the chromium background level exceeds the SLVs, indicating that this SLV is probably too conservative for use in the Portland area. Facility concentrations of chromium are below the background level and so this COI is not considered a CPEC. MDCs of arsenic, cadmium, copper, lead, and zinc exceeded regional background concentrations (Appendix C). Mercury was not detected in soil samples at a detection limit of 0.1 milligrams/kilogram (mg/kg), which is greater than the background level of 0.07 mg/kg.

Sixteen COIs were excluded as CPECs in riverbank soils because they were not detected and either 1) don't have SLVs; or 2) have a maximum detection limit that doesn't exceed the SLV. No analytes were excluded as CPECs based on frequency detection analysis where detects or detection levels exceeded SLVs.

Frequency of detection and background levels were not incorporated into the Level II screening evaluation for the historical Substation A area, since the two soil samples collected there were evaluated specifically for PCBs.

3.2.2 Screening Analysis

Identification of Candidate CPECs – Historical Substation A Soils

Appendix E presents soil MDCs for COIs evaluated at the historical Substation A area (PCBs and petroleum hydrocarbons), with comparisons to available SLVs for plants, invertebrates, birds, and mammals. All MDCs for COIs at the historical Substation A were below SLVs (or SLVs were lacking) for all receptors. Overall, the maximum risk ratio calculated for COIs compared to SLVs at the Substation A area is 0.067, which is well below the applicable benchmark of 5.

For birds and mammals, T calculation based on multiple COIs exceeded the threshold. However, calculations of risk ratios for this area are largely based on non-detected concentrations (i.e., eight of the twelve COIs were not detected). In addition, calculations of risk from multiple COIs is influenced by the number of COIs with SLVs (i.e., the contribution from each COI is greater in cases with a reduced COI/SLV list). In addition, the evaluation is influenced by the fact that the Aroclor 1254 SLV was applied to the other Aroclors that were evaluated, but lacked SLVs.

As a result of this Level II screening evaluation, PCBs and petroleum hydrocarbons at the historical Substation A area are deemed not to pose risk to ecological receptors and this sub-area will not be discussed further in this document.

Identification of Candidate CPECs – Riverbank soils

Appendix C presents riverbank soil MDCs, with comparisons to available SLVs for plants, invertebrates, birds, and mammals. COIs for which the MDC exceeded at least one SLV at the Q=5 level, or are identified as a result of potential risk to a receptor from multiple COIs simultaneously within a given medium, are considered "candidate CPECs" that are subject to further analysis, including calculation of 90UCLs, and comparison to appropriate risk ratios. The Facility does not have suitable habitat for T/E species and so a risk ratio of 5 corresponding to non-T/E species is the applicable benchmark for identifying CPECs (DEQ 2001). For riverbank soils in OU2, four candidate CPECs (copper, lead, zinc, and sum of HPAHs) were identified[1]. These candidate CPECs are discussed further in subsequent sections.

Comparison of MDCs to SLVs for Non-Wildlife Receptors – Riverbank Soils

Refer to Appendix C for the results of screens for plants and soil invertebrates (i.e., non-wildlife receptors) based on comparisons of the MDCs to SLVs. Since no T/E species are potentially present, a risk ratio of 5 corresponding to non-T/E species is the applicable benchmark for identifying CPECs (i.e., the MDC is greater than 5x-SLV) (DEQ 2001). Table 3-2 summarizes results of the soil toxicity screens for COIs for which the MDC exceeded at least one plant or invertebrate SLV with a risk ratio greater than 5. Zinc and copper were both identified as CPECs for plants and invertebrates (Table 3-2). Potential risks to plants and invertebrates from copper and zinc are further discussed in Section 4.0.

Comparison of 90UCLs to SLVs for Wildlife Receptors – Riverbank Soils

For bird and mammal receptors (i.e., wildlife receptors), EPCs based on 90UCLs were calculated for candidate CPECs; calculations were performed separately for discrete and composite samples. Refer to Appendix D for the results of screens based on comparisons of the calculated 90UCLs to SLVs. Since no T/E species are potentially present, a risk ratio of 5 corresponding to non-T/E species is the applicable benchmark for identifying CPECs (i.e., the 90UCL is greater than 5x-SLV) (DEQ 2001). Table 3-2 summarizes results of the soil toxicity screens for COIs for which either 90UCL (composite- or discrete-based) exceeded at least one bird or mammal SLV with a risk ratio greater than 5.

For birds, copper, lead, and zinc were identified as CPECs (both composite-based 90UCLs and discrete-based 90UCLs exceeded 5x-SLV). For mammals, copper and zinc were also identified as CPECs (based on either composite- or discrete-based 90UCLs exceeding 5x-SLV, not both)

[1] As noted in Section 3.2.1, Facility concentrations of chromium are below the background level and so chromium is not considered a CPEC.

(Appendix D and Table 3-2). The 90UCL for HPAHs did not exceed the 5x-SLV level and so adverse effects to birds or mammals are not expected from HPAHs in riverbank soils. Additional evaluation of the potential risks to birds and mammals from metals are further discussed in Sections 4.0 (expanded Level II analyses) and 5.0 (population-level probabilistic analyses), and overall conclusions are presented in Section 6.0.

4.0 EXPANDED LEVEL II ASSESSMENT

An objective of the Level II Screening is to determine whether additional ecological risk analysis is necessary to support risk management decisions for a site. Results of the Level II screening evaluation identified some metals that exceeded SLVs. Copper (plants, invertebrates, birds, mammals), lead (birds), and zinc (plants, invertebrates, birds, mammals) were identified as CPECs based on screening analyses using SLVs (Table 3-2). SLVs are intended as screening-level estimates of soil concentrations below which no adverse impacts are expected to ecological receptors under any exposure conditions. However, they are not meant as cleanup values and exceedance of the SLVs does not necessarily indicate unacceptable ecotoxicological risk, nor should they be used as cleanup criteria (DEQ 2001). EcoSSLs were developed in a similar context (USEPA 2005a).

Based on discussions with DEQ, additional risk analysis is included in this Level II ERA to provide additional context for the decisions to be addressed in TMDP 3 and TMDP 4 (discussed in Section 6.0). Specifically the goal of the Level II ERA is to determine whether a Level III ERA is necessary to support a risk management decision for OU2. Expanded Level II assessments for plants, invertebrates and wildlife are presented in the following sub-sections. For wildlife, exposure and risk calculations were conducted for birds, using the American robin as a representative species. Based on surveys of toxicity reference values presented in the EPA Eco SSL documents, birds are generally more sensitive than mammals to the metals that are evaluated in this report. As a result of this greater sensitivity and the habitat and environment at OU2, risk management decisions made based on protection of birds would be protective of mammals.

4.1 Expanded Level II Assessment – Plants/Invertebrates

Figure 4-1 shows detected zinc soil concentrations at each of the riverbank locations compared to SLVs and 5x-SLVs for plants and invertebrates. Zinc concentrations exceeded the 5x-SLV for plants (800 mg/kg) at one sampling location with the maximum sitewide concentration of zinc (835 mg/kg). However, overall zinc concentrations and qualitative observations during site visits do not indicate phytotoxicity along the riverbank. Zinc concentrations exceeded the 5x-SLV for invertebrates (600 mg/kg) at two locations along the riverbank. These results suggest that invertebrates at these locations could experience zinc exposures that exceed screening levels. Field observations associated with the Level I and Level II analysis did not reveal obvious patterns of phytotoxicity. Given the effects of the physical disturbance and the ruderal/invasive vegetation on natural ecological function, it is unlikely that ecological impacts from phytotoxicity could be identified through field data collection.

Figure 4-2 shows detected copper soil concentrations at each of the riverbank locations compared to SLVs and 5x-SLVs for plants (350 mg/kg) and invertebrates (400 mg/kg). Copper concentration exceeded the 5x-SLV for plants and invertebrates at 2 sampling locations along the riverbank. Based on this limited distribution, it seems unlikely that copper toxicity is limiting the plant and invertebrate communities at OU2.

4.2 Expanded Level II Assessment - Birds

Screening results for birds are presented in Table 3-2 and Appendix D. Zinc 90UCL concentrations for both composite and discrete samples exceed the 5x-SLV of 230 mg/kg for birds with a risk ratio ranging from 6.4 to 11.7. Copper 90UCL concentrations exceed the 5x-SLV of 140 mg/kg for birds with a risk ratio ranging from 6.1 to 18.9. Lead 90UCL concentrations exceed the 5x-SLV of 55 mg/kg for birds with a risk ratio ranging from 5.2 to 7.8.

Based on exceedances by concentrations of these CPECs in both discrete and composite soil samples, additional risk analysis for birds was conducted. This expanded Level II analysis focuses on estimating exposure to copper, lead and zinc for bird receptors and expands on the Level II screening by:

1. Identifying a representative bird receptor species with an omnivorous (plant and invertebrate) diet (American robin);

2. Replacing the simple comparison of site soil concentrations to SLVs with an estimation of daily intake of each chemical by birds through ingestion of prey and soils; and.

3. Comparing copper, lead, and zinc intake with a range of ecological benchmark values (EBVs) instead of a single SLV.

These steps are more consistent with the exposure assessment and risk characterization components of a baseline risk assessment and are intended to provide risk managers with additional information to support risk management decisions for copper, lead, and zinc in OU2 soils. The following sections provide a summary of the expanded Level II analysis for birds.

4.2.1 Representative Bird Receptor

The American robin (*Turdus migratorius)* was identified as the representative receptor for terrestrial-feeding birds because of its small home range and omnivorous diet, and because it was the basis for the DEQ SLVs for exposure of birds to metals in soils. Small birds, such as American robins, are sensitive to metals and represent the potentially most affected receptors. Use of birds to represent ecological risk at the Facility appears to be protective of mammalian wildlife, because birds are generally more sensitive to the CPECs than mammals. American robins have relatively small home ranges, and individuals could spend substantial amounts of their time along a riverbank area, feeding on both vegetation and invertebrates that could contact affected soils. Robins and similar birds are also food sources for avian and mammalian predators. Such predators are unlikely to be affected by contaminated soils at the Facility since most metals do not biomagnify in terrestrial food webs. However, adverse effects on robins or similar species could affect the abundance or quality of food resources for predators. Modeling food chain exposure to this receptor is a conservative approach that provides an estimate of exposure for the most limiting receptors at the Facility relative to other terrestrial receptors. Therefore, the American robin is a good representative for assessing potential risk to resident, terrestrial-feeding birds at the Facility. Because of the higher potential rates of uptake of metals in invertebrates compared to plants, this analysis assumes a 100% invertebrate diet in order to conduct a conservative evaluation.

4.2.2 Exposure Estimation Methodology

The additional risk analysis was based on standard methods for estimating exposure from food ingestion and incidental ingestion of soils (USEPA 2005a, 1993). Refer to Table 4-1 for a summary of parameters, exposure equations, and sources of data used in the estimation of intakes. Standard dietary intake equations were used to estimate the amount of copper, lead, and zinc that an avian receptor could obtain from ingestion of insect tissue. As directed by DEQ (2012), the overall food intake rate is from WDOE (2012). Other parameters are from the Wildlife Exposure Factors Handbook (USEPA 1993) and Attachment 4-1 of EcoSSL guidance (USEPA 2005a). Since no site-specific data on biological tissue were available, CPEC concentrations in food were estimated using empirically derived uptake relationships from ecotoxicological literature (i.e., Bechtel-Jacobs 1998 and Sample et al. 1999 as recommended in USEPA 2005a). In addition to the ingestion of CPECs accumulated in food items, robins may also be exposed to CPECs through the inadvertent ingestion of surface soil while foraging. Although wildlife receptors may also be exposed to CPECs through the ingestion of surface water, there is no surface water available on the Facility and this exposure pathway was considered incomplete for OU2.

The assimilation efficiency or bioavailability of zinc and copper in ingested soils or biota was assumed to be 100%. This is a conservative estimate since the bioavailability of most metals is less, especially directly from incidentally ingested soils or soils in gut content of prey items. Bioavailability of lead in soils was assumed to be 50%; lead bioavailability from ingested food was assumed to be 100%. These assumptions are conservative in that actual lead bioavailability can be much lower, especially from inorganic forms of lead ore or mill tailings (Ruby et al. 1992), and lead iron oxides that tend to form in soils from soluble forms of lead (Suedel et al. 2006, Schoof 2003). Lead carbonates and organic forms have higher bioavailability (80%) (Suedel et al. 2006, Schoof 2003). Calculation of total intake also assumes that all animals in the subpopulation being assessed obtain 100% of exposure from areas under evaluation (i.e., area use factor equal to 100%).

4.2.3 Ecological Benchmark Values (EBVs)

In the context of this assessment, EBVs are exposure rates that are associated with levels of toxicological effects. The exposure rates are expressed as mg of CPEC ingested per Kg body weight, per day (mg/Kg BW/day). As a result, EBVs can be directly compared to the exposure rates estimated using methods described above.

The analysis in this report includes a range of EBVs, representing a range of lethal/sub-lethal toxicological effects and survival, obtained from widely used and accepted toxicological literature sources, consistent with the assumptions outlined in the DEQ guidance (DEQ 2001), and additional direction from DEQ (DEQ 2012). Refer to Table 4-2 for the EBVs that were used in the expanded Level II risk estimation.

In general, mortality-based no-observed-adverse-effects levels (NOAELs) indicate levels at or below which no mortality is expected. Mortality-based lowest-observed-adverse-effect-levels (LOAELs) indicate the lowest test dose at which statistically significant mortality was observed.

In DEQ's probabilistic risk assessment process (Level III in DEQ 2001), EBVs for receptor populations are defined as the median lethal dose or concentration (LD50 or LC50), i.e., based on a lethality endpoint and corresponds to exposures in which 50% of test animals survived. If a LD50 or LC50 is not available for endpoint species considered in the risk assessment, the EBV may be derived from other toxicological endpoints for those receptors (adjusted with uncertainty factors as appropriate), and based, to the extent practicable, on studies whose routes of exposure and duration of exposure are commensurate with the expected routes and duration of exposure for endpoint species considered in the risk assessment (DEQ 2001). DEQ provides guidance in this regard, but they do not provide the LC50 values. Because a Level III probabilistic analysis is used in Section 5, mortality-based endpoints are included in Table 4-2 and the exposure analysis.

Satisfactory LD50 or LC50 EBVs were not available for the CPECs, primarily because of exposure routes and study designs in which lethality measure were derived. Although it is not directly comparable to an LC50, one can infer that if the LOAEL is generally based on less than 50% mortality, then it is likely less than an LC50, if one were available. Exceptions to this assumption are possible, so the results should be interpreted using the data from the toxicological studies on which the LOAEL is based. Calculated EBVs for copper, lead and zinc are included in Appendix G.

4.2.4 Expanded Level II Analysis Results - Birds

Results of the exposure calculation and comparison to the EBVs are shown in Table 4-3. Results based on both the discrete- and composite-based 90UCLs are presented. In addition, an estimate of exposure from regional background levels was also calculated for comparison purposes. A toxicity quotient (TQ) was calculated as the ratio between the estimated exposure and the EBV (DEQ 2001):

Toxicity quotient (TQ) = exposure estimate/EBV

DEQ does not have specific guidance for interpreting the results of deterministic exposure analyses such as that shown for the 'expanded' Level II analysis. In most ecological risk assessment contexts, NOAEL-based TQs equal to or less than 1.0 indicate no adverse effects are expected (i.e., *de minimis* risk) and no further risk analysis is necessary to support site risk management decisions (see for example, USEPA 1997). NOAEL HQs greater than 1 do not necessarily indicate unacceptable risk, but that additional risk analysis may be necessary to support risk management decisions. LOAEL TQs greater than 1 also may not necessarily equate to unacceptable risk, but indicate that sensitive individuals in a population may be affected. At exposures increasingly greater than the LOAEL, a greater number of individuals could be affected, and if exposures are high enough, or widespread enough, adverse impacts on populations could occur.

Table 4-3 shows TQs calculated for each EBV based on the exposure estimates calculated from discrete and composite samples, and for exposure calculated using background soil concentrations for each of the metals. Important aspects of the TQ results are:

- TQs exceeding 1.0 are observed for NOAELs for sublethal- and mortality-based endpoints for each of the chemicals, for composite and discrete sample groups.
- TQs exceeding 1.0 for sublethal NOAELs are also observed for background metal concentrations.
- For zinc, LOAEL-based TQs exceeded 1.0 for discrete and composite samples. No LOAEL-based TQ exceeded 1.8. No LOAEL-based TEQs exceeded 1.0 for background concentrations.
- For lead, no LOAEL-based TQs exceeded 1.0 for composite or discrete samples, or for background concentrations.
- For copper, no LOAEL-based TQs exceeded 1.0 for composite samples or background concentrations. LOAEL-based TQs exceeded 1.0 for discrete samples, with a maximum of 2.5.

Because at least one NOAEL-based TQ exceeded 1.0 for each of the metals, risk cannot be assumed *de minimis* based on this simple comparison alone. The LOAEL-based TQs are relatively low for all three metals, with none exceeding 1.0 for lead. As discussed with DEQ, additional context for risk management decisions can be provided through the probabilistic population-based analysis described in DEQ Level III guidance.

5.0 POPULATION-LEVEL PROBABILISTIC EVALUATION

Based on the relative distribution of chemicals and the relative sensitivity of the Level II assessment endpoints (i.e., birds), a supplemental population-level probabilistic evaluation provides additional information to determine if risk management actions are needed for metals that exceeded conservative screening values established by DEQ. This evaluation was conducted for birds, assuming that they are as sensitive, or more sensitive as mammals to the CPECs. Based on the potential future use of the Facility as industrial, it is assumed that population-level effects are conservative for most species and that the loss of a single individual is not critical to the population or community. The following sections summarize the population-level probabilistic analysis methodology and results.

The overall goal of the analysis (i.e., the risk hypothesis) was based on the DEQ Acceptable Risk Level (ARL) for non-T/E species (DEQ 2001; OAR 340-122-115(6)). Specifically, the analysis evaluated whether American robins would be exposed to CPECs in the area of consideration (called the contaminated area [CA] in DEQ guidance) at concentrations that may result in exposures that exceed the ARL. For non-T/E species, the ARL is defined as a probability greater than 10 percent (%), that 20% or more of the local population experiences exposures greater than the EBV for a given CPEC. Similarly to the expanded Level II analysis, the TQ is defined as the ratio of the exposure estimate to the EBV for each CPEC (DEQ 2001; OAR 340-122-115(5)). This analysis was conducted using the same exposure parameters and EBVs outlined in Section 4; refer to Tables 4-1 and 4-2.

5.1 Population-Level Exposure Analysis and Risk Estimation Methodology

The goal of the population-level exposure analysis is to estimate the rate at which representative receptors are exposed to CPECs in the CA (i.e., riverbank area). Estimating exposure for the endpoint receptor population requires defining local population boundaries, determining habitat size and quality, identifying exposure parameters (e.g., feeding range, body size, food ingestion rates) and estimating exposure. Estimating exposure, which is the dose of a hazardous substance occurring at a location of potential contact between an ecological receptor and the hazardous substance, is the focus of an exposure analysis (DEQ 2001).

To evaluate risks to non-T/E species, the focal population to be assessed should be an ecologically significant unit within the CA (Hope and Peterson 2000). Within the breeding season, terrestrial birds, such as the American robin, have relatively restricted feeding ranges during their time of residence at a site. Thus, American robins are likely to be resident at the riverbank area of the Facility and represent a local population exposed to affected soils. It is likely that the local robin population extends well beyond the Facility, and probably the surrounding areas. However, assessment of the (sub) population in the riverbank area of the Facility provides a conservative measure of potential exposure for purposes of this ERA.

The population-level probabilistic risk analysis was performed in accordance with DEQ (2001; adapted from Hope and Peterson 2000) in Appendix F. The probabilistic risk evaluation involves: (1) estimating the number of individuals (n) of the receptor within the location population boundary; (2) estimating the probability (P) that an individual receptor will experience an exposure in excess of the EBV; (3) and calculating the probability that more than 20% of the local population will experience exposures greater than the EBV, and (4) assessing whether the ARL is exceeded. If the probability that more than 20% of the local population will experience exposures greater than the EBV is greater than 10%, then risk exceeds the ARL. Refer to DEQ (2001 and 2006c) for the specific equations developed for these calculations.

Using Geographic Information System (GIS) methodology, the calculated size of the CA (i.e., riverbank area – extending below property boundary to beach area) is 5.54 acres (2.24 hectare [ha]). Restricting the analysis to the riverbank area is conservative since the local robin subpopulation likely extends beyond the site. The assessment population area for the modeled receptors corresponds to 5 home-range (HR) diameters, and was calculated using Equation 2 in DEQ (2001):

$$A = (100*HR)/pi$$

The annual average home range of the American Robin is 0.15 ha (USEPA 1993) and so the calculated "assessment population area" is estimated at 4.8 ha, which is larger than the CA (i.e., riverbank area). With an estimated average density of 5.16 pairs per ha (USEPA 1993), the modeled population size of American robins in the CA is approximately 49 individuals. As indicated previously, this exposure model assumes even and random access by receptors to all portions of the riverbank area.

The probability (P) that an individual receptor will experience an exposure in excess of the EBV was calculated using the following equation (DEQ 2006c):

$$P = \Phi_z(x_{exp} - ln(EBV)/s_{exp})$$

where:

p = Probability of exposure > EBV (unitless)
ϕZ = Cumulative distribution function of a standard normal random variable (MS-Excel® NORM.S.DIST function)
xEXP = Mean of exposure dose (mg/kg/day)
sEXP = Standard deviation of exposure dose (mg/kg/day)
EBV = Ecological Benchmark Value (mg/kg bw/day)

Where environmental data are found to be lognormally distributed instead of normally distributed, the log transformation of both the dose and the EBV are necessary.

The following equation (DEQ 2006c) is used to calculate b, the probability that more than 20% of the total local population will receive an exposure exceeding the TRV:

$$b = 1 - \sum_{i=0}^{y} \left[\left(\frac{n!}{i!\,(n-i)!} \right) p^{i} (1-p)^{(n-i)} \right] = 1 - BINOM.DIST(y, n, p, true)$$

where:
y = 20 percent of the population [y = INT(0.2n)]
n = size of the local population
p = probability of individual exposure > EBV
b = probability that more than 20% of the total population will have exposure > EBV
INT = MS-Excel® integer function
BINOM.DIST = MS-Excel® binomial distribution function (cumulative)

As used here, the cumulative BINOM.DIST function calculates the probability (b) that 20% or more (y) of the population will be exposed to a dose greater than the EBV. To calculate the probability that more than y percent of the population will be exposed to a dose greater than the EBV, the expression 1 – BINOM.DIST is used. The resulting probability is compared to the population-level ARL.

5.2 Population-Level Probabilistic Analysis Results

Results are summarized on Table 5-1 and Appendix F-1 through F-6 provides calculation worksheets for each CPEC, and provides separate calculations for discrete and composite samples. The interpretation of results without an LC50 value has not been established by DEQ, but the following rationale was used help interpret the results:

- If the probability of exceeding a mortality-based NOAEL is <0.1, then exposures cannot exceed the ARL for an LC50 value and risk should be considered acceptable.
- If the probability of exceeding a mortality-based LOAEL is <0.1, the LOAEL study endpoint is based on less than 50% mortality of test organisms, and the probabilities of exceeding reproduction/growth-based NOAELs and/or LOAELs is likely less than 0.1, then exposures probably do not exceed the ARL for an LC50 value and risk should be considered acceptable.
- If the probability of exceeding a mortality-based LOAEL is equal to or greater than 0.1, and the LOAEL is based on <50% mortality of test organisms, and the probabilities of exceeding reproduction/growth-based NOAELs and/or LOAELs are less than 0.1, then the LOAEL likely represents exposures less than the LC50, and risk should be considered acceptable. But specific conditions at the site (habitat, site size, relationship

to other habitats, and form of the chemical) should be considered and discussed with DEQ.

- If the probability of exceeding mortality-based LOAEL is equal to or greater than 0.1, and the LOAEL is based on equal to or greater than 50% mortality of test organisms and is at the higher end of the LOAEL spectrum, then the LOAEL could represent exposures equal to or greater than the ARL, and risk could be unacceptable. Indications of unacceptable risk increase as the number of LOAELs and NOAELs with probabilities >0.1 increase.

Results summary for Zinc:

In Table 4-2, the EBV value of 271 mg/Kg BW/day represents a geometric mean of the mortality based LOAELs values from studies included in USEPA EcoSSL development. The geometric mean is for studies that were at least 4 weeks in duration, and based on food-borne exposure to zinc. The probability of exceeding this value was far less than the ARL (0.1) for discrete and composite samples (Table 5-1). Note that the benchmark value of 87.1 was a LOAEL associated with about 43% mortality (3 out of 7) (Gibson et al, 1986). The probability of exceeding this level of exposure is estimated to be high (1.0). However, since the geometric mean of LOAELs represents a wider sampling of test results, it would seem to be a better indicator for the risk of toxicity.

Results summary for Lead:

The probability of lead exposure greater than the mortality-based NOAEL (22 mg/Kg BW/day) was less than 0.1. This EBV is the geometric mean of mortality-based NOAELs listed in the EcoSSL for lead (Table 5.1, EPA 2005), and so represents multiple studies that of high enough quality to be included in the EcoSSL analysis. These results indicate risk from lead to the local bird populations likely does not exceed ARLs.

Results summary for Copper:

Two mortality-based LOAELs were included in the EBVs (values of 42 and 68.4 mg/Kg BW/day in Table 4-2). The probability of exceeding the higher of the EBVs did not exceed 0.1 for either composite or discrete samples (Table 5-1). This EBV is based on a commonly cited reference for copper toxicity levels in birds, and corresponds to a mortality rate of about 40% (Mehring et al. 1960). The probability of exceeding the lower of the EBVs exceeded 0.1 for discrete, but not composite samples. The lower EBV is based on the geometric mean of mortality LOAELs from the Eco SSL document for copper (EPA 2007). The level of mortality among the references used in this mean is not known, but is probably less than 50%.

Overall, the probabilistic analysis indicates that risks from zinc, lead, and copper are below the ARL defined for population-level risk analysis because probability of exposures exceeding mortality-based LOAELs is less than 0.1. Since formally derived LC50/LD50s that are suitable for this analysis were not available, NOAEL- and LOAEL-based analyses are substituted (Appendix G). The NOAEL, and probably the LOAEL, are lower exposure levels than the LC50/LD50 values identified for the Oregon ARL, and substitution of these benchmarks is likely more protective than use of the LC50/LD50 values. Therefore, if probability of exceeding a mortality-based LOAEL is less than 0.1, then risks for the site are likely to be below the ARL. Individuals that use contaminated point locations heavily may experience exposure exceeding the EBV, but the probabilistic analysis conducted using DEQ Level III guidance indicates that ARLs are not exceeded.

6.0 ECOLOGICAL RISK ASSESSMENT CONCLUSIONS

6.1 Overall Level II ERA Conclusions

Based on the Level I Scoping and Level II Screening processes, concentrations of copper (plants, invertebrates, birds, mammals), lead (birds), and zinc (plants, invertebrates, birds, mammals) exceed screening levels established by DEQ to prompt additional evaluation to support risk management decisions. Exceedance of the SLVs does not necessarily indicate unacceptable risk and ODEQ guidance identifies additional risk analysis steps that can be used to support risk management decisions. For SIUF OU2, the additional analysis included mapping locations at which concentrations exceeded SLVs for plants and invertebrates, and conducting expanded exposure and risk analysis for wildlife.

Exceedances for plants and invertebrates appear to be isolated in subsections of the site, suggesting that individuals in those locations may experience exposures greater than the SLVs. However, the locations with exceedances represent a relative small part of the site, limiting the area of the site in which toxicity may impair overall ecological functions. In addition, the relatively disturbed and ruderal nature of the vegetation community makes it unlikely that this area of riverbank and adjacent area provide substantial ecological function in the local ecosystem.

The expanded Level II exposure analysis and the population-level probabilistic evaluation suggests that exposure of birds could exceed some sublethal and mortality-based LOAEL EBVs, but do not exceed the ARL set by DEQ based on LC50/LD50 endpoints. Therefore, ecological risk at this site is within acceptable ranges and no remedial action is needed to protect ecological receptors and ecological function in the area.

6.2 Technical-Management Decision Points (TMDPs)

According to DEQ guidance (2001), TMDPs are steps in the risk assessment process where one of three recommendations is determined: 1) no further ecological investigations at OU2; 2) continuation of the risk assessment process to the next level; or 3) undertake a removal or remedial action. DEQ guidance identifies two TMDPs at the end of the Level II screening process. The information gathered during the Level I Scoping and Level II Screening processes are used to evaluate TMDP 3 and TMDP 4, as discussed further here.

6.2.1 TMDP 3

This TMDP is intended to help determine whether unacceptable ecological risk is probable. According to DEQ guidance (2001), the potential for risk exists when CPECs are present and there are complete exposure pathways between contaminated media and ecological receptors. The Level I scoping indicated that the potential for exposure exists at riverbank areas of OU2 based on the presence of habitat, albeit of marginal quality, and possible contact of ecological receptors to contaminants transported to those areas. However, the guidance indicates that unacceptable risk is probable only if the locality exhibits the following three criteria: 1) contains any individuals of a T/E species, critical habitat of a T/E species, or contains habitat of sufficient size and quality to support a local population of non-T/E species; 2) CPECs were selected on the basis of exceedance of SLVs or because they have a high potential to bioaccumulate; and 3) there appears to be plausible links between CPEC sources and endpoint receptors (DEQ 2001).

As described in the Level I ERA, and referenced above, there are no known T/E species and the habitat size and quality at OU2 is currently relatively low. By itself, it may not be sufficient to support a self-propagating population of vertebrate wildlife receptors such as birds or mammals. The CPECs identified in the Level II screening evaluation were identified based on the exceedance of SLVs. However, the expanded Level II analysis and supplemental population-level probabilistic evaluations suggests low risk of toxic exposure to individuals at OU2, and low risk to local populations if the site exposure remains at current levels.

In terms of links between CPEC sources and endpoint receptors, OU2 is currently designated for industrial use and is expected to remain so for the foreseeable future. As a result, terrestrial wildlife receptors are unlikely to spend substantial amounts of time feeding or engaged in other behaviors that would result in substantial contact with soils in these upland areas at OU2. The riverbank areas of OU2 contain more extensive vegetation, but do not represent significant habitat for rare or important plant communities and include substantial portion of non-native species. Decisions regarding the probability of unacceptable risk from environmental media should include consideration of these factors. Based on these results, the probability of unacceptable ecological risk from upland soils is minimal, and does not warrant additional remediation at OU2.

6.2.2 TMDP 4

This TMDP assesses whether a remedial action decision is possible based on the existing information and current levels of uncertainty. Specifically, if cleanup would be less costly than further investigation and data are adequate to select and approve a remedy action, then further ecological investigation should be deferred in favor of a response action. The alternative is for the assessment process to proceed to Level III for further evaluation. Based on information gathered during the Level I Scoping and Level II Screening processes, including the expanded

Level II analysis and supplemental population-level probabilistic evaluations, the existing information is adequate to conclude that remediation at OU2 is not necessary based on ecological risk.

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TABLES

TABLE 3.1 Screening Level Summary Table

Constituents of Interest (COIs)			Background Levels[3]	Plants			Invertebrates			Birds			Mammals		
CASNo	Analyte[1]	Analyte Group/Methods[2]	Natural Background Soil Concs (mg/kg)	Oregon DEQ Level II SLVs[4] (mg/kg)	Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg)	Oregon DEQ-Approved Level II SLVs[6]	Oregon DEQ Level II SLVs[4] (mg/kg)	Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg)	Oregon DEQ-Approved Level II SLVs[6]	Oregon DEQ Level II SLVs[4] (mg/kg)	Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg)	Oregon DEQ-Approved Level II SLVs[6]	Oregon DEQ Level II SLVs[4] (mg/kg)	Oregon DEQ-Requested Alternative Screening Levels[5] (mg/kg)	Oregon DEQ-Approved Level II SLVs[6]
78763-54-9	Butyltin Ion	Butyltins	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14488-53-0	Dibutyltin Ion	Butyltins	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1461-25-2	Tetrabutyltin Ion	Butyltins	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
688-73-3	Tributyltin	Butyltins	NA	NA	NA	NA	NA	NA	NA	28	NA	28	1300	NA	1300
7440-36-0	Antimony	Metals	4	5	NA	5	NA	78 [d]	78	NA	NA	NA	15	0.27 [d]	0.27
7440-38-2	Arsenic	Metals	7	10	18 [d]	18	60	NA	60	10	43 [d]	43	29	46 [d]	46
7440-39-3	Barium	Metals	NA	500	NA	500	3000	330 [d]	330	85	NA	85	638	2000 [d]	2000
7440-43-9	Cadmium	Metals	1	4	32 [d]	32	20	140 [d]	140	6	0.77 [d]	0.77	125	0.36 [d]	0.36
1308-38-9	Chromium	Metals	42	1	NA	1	0.4	NA	0.4	4	26 [d]	26	410	34 [d]	34
7440-50-8	Copper	Metals	36	100	70 [d]	70	50	80 [d]	80	190	28 [d]	28	390	49 [d]	49
7439-92-1	Lead	Metals	17	50	120 [d]	120	500	1700 [d]	1700	16	11 [d]	11	4000	56 [d]	56
7439-97-6	Mercury	Metals	0.07	0.3	NA	0.3	0.1	NA	0.1	1.5	NA	1.5	73	NA	73
7440-02-0	Nickel	Metals	38	30	38 [d]	38	200	280 [d]	280	320	210 [d]	210	625	130 [d]	130
7782-49-2	Selenium	Metals	2	1	0.52 [d]	0.52	70	4.1 [d]	4.1	2	1.2 [d]	1.2	25	0.63 [d]	0.63
7440-22-4	Silver	Metals	1	2	560 [d]	560	50	NA	50	NA	4.2 [d]	4.2	NA	14 [d]	14
7440-66-6	Zinc	Metals	86	50	160 [d]	160	200	120 [d]	120	60	46 [d]	46	20000	79 [d]	79
132-64-9	Dibenzofuran	PAHs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.002	NA	0.002
90-12-0	1-Methylnaphthalene	PAHs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
91-57-6	2-Methylnaphthalene	LPAHs	NA	10	NA	10	NA	NA	NA	NA	NA	NA	3900	NA	3900
83-32-9	Acenaphthene	LPAHs	NA	20	NA	20	NA	NA	NA	NA	NA	NA	3900	NA	3900
208-96-8	Acenaphthylene	LPAHs	NA	10	NA	10	NA	NA	NA	NA	NA	NA	3900	NA	3900
120-12-7	Anthracene	LPAHs	NA	10	NA	10	NA	NA	NA	NA	NA	NA	3900	NA	3900
56-55-3	Benz(a)anthracene	HPAHs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	125	NA	125
50-32-8	Benzo(a)pyrene	HPAHs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	125	NA	125
205-99-2	Benzo(b)fluoranthene	HPAHs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	125	NA	125
191-24-2	Benzo(g,h,i)perylene	HPAHs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	125	NA	125
207-08-9	Benzo(k)fluoranthene	HPAHs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	125	NA	125
218-01-9	Chrysene	HPAHs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	125	NA	125
53-70-3	Dibenz(a,h)anthracene	HPAHs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	125	NA	125
206-44-0	Fluoranthene	HPAHs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	125	NA	125
86-73-7	Fluorene	LPAHs	NA	10	NA	10	30	NA	30	NA	NA	NA	3900	NA	3900
193-39-5	Indeno(1,2,3-cd)pyrene	HPAHs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	125	NA	125
91-20-3	Naphthalene	LPAHs	NA	10	NA	10	NA	NA	NA	NA	NA	NA	3900	NA	3900
85-01-8	Phenanthrene	LPAHs	NA	10	NA	10	NA	NA	NA	NA	NA	NA	3900	NA	3900
129-00-0	Pyrene	HPAHs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	125
LPAH	Low-Molecular Weight PAHs (sum) [a]	LPAHs	NA	NA	NA	NA	NA	29 [d]	29	NA	NA	NA	NA	100	100
HPAH	High-Molecular Weight PAHs (sum) [b]	HPAHs	NA	NA	NA	NA	NA	18 [d]	18	NA	NA	NA	NA	1.1	1.1
12674-11-2	Aroclor 1016	PCBs	NA	NA	NA	NA	NA	NA	NA	0.7	NA	0.7	100	NA	100
11104-28-2	Aroclor 1221	PCBs	NA	NA	NA	NA	NA	NA	NA	0.7	NA	0.7	4	NA	4
11141-16-5	Aroclor 1232	PCBs	NA	NA	NA	NA	NA	NA	NA	0.7	NA	0.7	4	NA	4
53469-21-9	Aroclor 1242	PCBs	NA	NA	NA	NA	NA	NA	NA	1.5	NA	1.5	5	NA	5
12672-29-6	Aroclor 1248	PCBs	NA	NA	NA	NA	NA	NA	NA	0.7	NA	0.7	4	NA	4
11097-69-1	Aroclor 1254	PCBs	NA	NA	NA	NA	NA	NA	NA	0.7	NA	0.7	4	NA	4
11096-82-5	Aroclor 1260	PCBs	NA	NA	NA	NA	NA	NA	NA	0.7	NA	0.7	4	NA	4
37324-23-5	Aroclor 1262	PCBs	NA	NA	NA	NA	NA	NA	NA	0.7	NA	0.7	4	NA	4
11100-14-4	Aroclor 1268	PCBs	NA	NA	NA	NA	NA	NA	NA	0.7	NA	0.7	4	NA	4
1336-36-3	Total Aroclors [c]	PCBs	NA	40	40[f]	40	NA	NA	NA	NA	0.65 [f]	0.65	4	0.65[f]; 0.371[f]	0.371
117-81-7	Bis(2-ethylhexyl) Phthalate	Phthalates	NA	NA	NA	NA	NA	NA	NA	4.5	NA	4.5	1020	0.925 [g]	0.925
85-68-7	Butyl Benzyl Phthalate	Phthalates	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.239 [g]	0.239
84-66-2	Diethyl Phthalate	Phthalates	NA	100	NA	100	200	NA	200	NA	NA	NA	250000	24.8 [g]	24.8
131-11-3	Dimethyl Phthalate	Phthalates	NA	100	NA	100	200	NA	200	NA	NA	NA	250000	734 [g]	734

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84-74-2	Di-n-butyl Phthalate	Phthalates	NA	200	NA	200	NA	NA	NA	0.45	NA	0.45	30000	0.15 [g]	0.15
117-84-0	Di-n-octyl Phthalate	Phthalates	NA	NA	NA	NA	NA	NA	NA	0.45	NA	0.45	30000	709 [g]	709
HORHC	Heavy Oil Range Hydrocarbons	TPH (418.1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diesel	Diesel	TPH (HCID)	NA	NA	NA	NA	NA	200 [e]	200	NA	6000 [e]	6000	NA	6000 [e]	6000
Gasoline	Gasoline	TPH (HCID)	NA	NA	NA	NA	NA	100 [e]	100	NA	5000 [e]	5000	NA	5000 [e]	5000
Oil	Oil	TPH (HCID)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diesel	Diesel	TPH (NWTPH-Dx)	NA	NA	NA	NA	NA	200 [e]	200	NA	6000 [e]	6000	NA	6000 [e]	6000
Oil	Oil	TPH (NWTPH-Dx)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gasoline	Gasoline	TPH (NWTPH-Gx)	NA	NA	NA	NA	NA	100 [e]	100	NA	5000 [e]	5000	NA	5000 [e]	5000

Notes :

1 - Notes about summed analytes:

a - Sum of Low Molecular Weight PAHs (LPAHs): Sum of the detected LPAHs or the highest detection limit when not detected. LPAHs have three or fewer aromatic rings and include: 2-Methylnaphthalene, Acenaphthene, Acenaphthylene, Anthracene, Fluorene, Naphthalene, Phenanthrene. 1-Methylnaphthalene was not included in the sum.

b - Sum of High Molecular Weight PAHs (HPAHs): Sum of the detected HPAHs or the highest detection limit when not detected. HPAHs have four or more aromatic rings and include: Benz(a)anthracene, Benzo(a)pyrene,Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Pyrene. Dibenzofuran was not included in the sum.

c- Total Aroclors: Sum of the detected Aroclors or the highest detection limit when not detected.

2 - Notes about analyte types/methods:

Metals analysis by U.S. Environmental Protection Agency (EPA) 6000/7000 Series Methods

Polynuclear Aromatic Hydrocarbons (PAHs) by U.S. Environmental Protection Agency (EPA) Method 8270 C SIM

Phthalates by U.S. Environmental Protection Agency (EPA) Method 8270C

Polychlorinated Biphenyl (PCB) Aroclors by U.S. Environmental Protection Agency (EPA) Method 8082

Butyltins by Krone Method

TPH results from different analytical methods kept separate.

TPH-Gx = Gasoline-range Total Petroleum Hydrocarbons (TPH) by Northwest Method NWTPH-Gx

TPH-Dx = Diesel-range Total Petroleum Hydrocarbons (TPH) by Northwest Method NWTPH-Dx (with silica gel cleanup)

HCID = Total Petroleum Hydrocarbons (TPH) Identification by Northwest Method NWTPH-HCID

418.1 =Total Petroleum Hydrocarbons (TPH) by EPA Method 418.1

3 - Background levels: Oregon Department of Environmental Quality (DEQ). 2002. DEQ Toxicology Workgroup Memorandum to DEQ Cleanup Project Managers regarding "Default background concentrations for metals". October 28, 2002.

4 - Oregon DEQ Level II Screening Level Values (SLV) from Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final April 1998, updated May 2001.

chromium VI SLV applied to chromium

mercury (elemental, total) SLV applied to mercury

arsenic III SLV applied to arsenic

Aroclor 1254 SLV applied to Aroclors without criteria

naphthalene SLV applied to LPAHs without criteria

di-n-butyl phthalate SLV applied to di-n-octyl phthalate

tributyltin oxide SLV applied to tri-n-butyltin

diethyl pthalate SLV applied to dimethyl pthalate

chromium III SLV applied to chromium

benzo(a)pyrene SLV applied to HPAHs without criteria

5 - In June 6, 2012, Oregon DEQ provided input during a conference call on requested alternative screening values because DEQ soil values are currently outdated for several SLVs.

d - Oregon DEQ requested that for metals and PAHs, USEPA Ecological Soil Screening Levels (EcoSSLs) should be used instead of DEQ SLVs. Source: U.S. Environmental Protection Agency (USEPA). 2005. Guidance for Developing Ecological Soil Screening Levels (EcoSSLs). USEPA Office of Solid Waste and Emergency Response (OSWER), OSWER Directive 9285.7-55. Published November 2003, Revised November 2005 and subsequent contaminant-specific EcoSSL documents.

e - Oregon DEQ requested that TPH values are available from Washington Department of Ecology Model Toxics Control Act (MTCA). Source: Washington State Department of Ecology (WDOE). 2012. Table 749-3: Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/table_749-3.pdf. From: Table Terrestrial Ecological Evaluation (TEE) Process - The Site-Specific Evaluation. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/site-specific.htm. Toxics Cleanup Program, Model Toxics Control Act Cleanup (MTCA) Regulation. Accessed 6/19/2012. Values for "wildlife" were applied to both birds and mammals.

f - Oregon DEQ requested that for PCBs, the ERA should evaluate a bioaccumulation screening level value, which are available from Oak Ridge National Laboratory (ORNL) or Washington Department of Ecology (WDOE) Model Toxics Control Act (MTCA).

ORNL source: Efroymson, R.A., Suter, G.W.II, Sample, B.E., and Jones, D.S. 1997. 1997. Table 4: Preliminary Remediation Goals for Soils, in Preliminary Remediation Goals for Ecological Endpoints. Prepared for the U.S. Department of Energy, Office of Environmental Management. Available at http://www.clu-in.org/download/contaminantfocus/dnapl/Toxicology/doe_prg_tm162r2.pdf. August 1997. Value for total aroclors is based on exposures to shrews (and the document indicates "toxic concentration benchmarks are not available for earthworms. Therefore, the PRG cannot be assumed to protect earthworms."), and so the value was applied to mammals only.

WDOE source: Washington State Department of Ecology (WDOE). 2012. Table 749-3: Ecological Indicator Soil Concentrations (mg/kg) for Protection of Terrestrial Plants and Animals. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/table_749-3.pdf. From: Table Terrestrial Ecological Evaluation (TEE) Process - The Site-Specific Evaluation. Available at: http://www.ecy.wa.gov/programs/tcp/policies/terrestrial/site-specific.htm. Toxics Cleanup Program, Model Toxics Control Act (MTCA) Cleanup Regulation. Accessed 6/19/2012. Values for "wildlife" were applied to both birds and mammals.

g - Oregon DEQ requested that for phthalates, EPA Region 5 provides additional SLVs for soil. Source: U.S. Environmental Protection Agency (USEPA). 2003. Region 5 RCRA Corrective Action, Ecological Screening Levels. Available at http://www.epa.gov/Region5/waste/cars/esl.htm. August 2003. The ESLs represent a protective benchmark (e.g., chronic no adverse effect levels); soil ecological screening levels are based on exposure to the Masked Shrew (Sorex cinerus). In this assessment, criteria are applied to mammals only.

6 - The final Oregon DEQ-approved Level II Screening Level Value (SLV) to be used in the risk evaluation is the Oregon DEQ-requested alternative value (footnote 5) where available, then the Oregon DEQ SLVs (Oregon DEQ 2001; footnote 4).

TABLE 3-2 Summary of CPECs - Riverbank Soils

Swan Island OU2 Upland Facility - Riverbank Soils - Oregon Screening Levels (Ecological Receptors)

Candidate CPECs	Plants[1]	Invertebrates[1]
	MDC	MDC
Chromium	YES	YES
Copper	**YES**	**YES**
Zinc	**YES**	**YES**

1 - For plants and invertebrates, CPECs are COIs whose MDCs exceed an Oregon DEQ-approved Level II SLV at the Q=5 level for non-T/E species and background levels, as indicated with highlighting.

Candidate CPECs	Birds[2]		Mammals[2]	
	90UCL (composite)	90UCL (discrete)	90UCL (composite)	90UCL (discrete)
Copper	**YES**	**YES**	**YES**	NO
Lead	**YES**	**YES**	NO	NO
Zinc	**YES**	**YES**	NO	**YES**
High-Molecular Weight PAHs (sum)	NO	NO	NO	NO

2 - For birds and mammals, CPECs are COIs whose 90UCLs exceed an Oregon DEQ-approved Level II SLV at the Q=5 level for non-T/E species and background levels, as indicated with highlighting.

Notes:
CPECs - contaminants of potential ecological concern
SLV - screening level value
DEQ - Oregon Department of Environmental Quality
MDC - maximum detected concentration
90UCL - 90% upper confidence limit
HQ - hazard quotient
T/E - threatened/endangered

TABLE 4-1 Approach for Calculation of Estimated CPEC Intake for Modeled Receptor - American Robin

Swan Island OU2 Upland Facility Riverbank Soils

Modeled Receptor: American Robin

Intake Equations:

Equation (a) - total CPEC intake

$$Intake_{total} = Intake_{food} + Intake_{water} + Intake_{soil}$$

Parameters - Equation (a):

Parameter	Description	Units	Value	Source/Notes
$Intake_{food}$	average daily intake from ingestion of prey items (vegetation and animal tissues).	mg/kg	calculated	See Equation (b)
$Intake_{soil}$	average daily intake from incidental ingestion of surface soil.	mg/kg	calculated	See Equation (c)
$Intake_{water}$	average daily intake from the ingestion of water.	mg/kg	0	No surface water at Upland Facility; water intake assumed to be 0.

Equation (b) - CPEC intake from food

$$Intake_{food} = AUF * \left(\sum_{i=1}^{N} B_{ij} * P_i * FIR \right)$$

Parameters - Equation (b):

Parameter	Description	Units	Value	Source/Notes
$Intake_{food}$	Intake for contaminant (j) in food	mg dw/kg bw-d	calculated	
AUF	Area use factor	unitless	1	Fraction of food derived from site; area use assumed to be 100%
FIR	Food intake rate	kg dw/kg bw-d	0.207	WDOE 2012 - food ingestion rate for American Robin
B_{ij}	Concentration of contaminant (j) in biota type (i) where $\ln(B_{ij})$ = $Intercept_{ij}$+$Slope_{ij}$*$\ln(Soil_j)$	mg/kg dw	Copper: $\ln(B_{plants})$=(0.394*$\ln(Soil_j)$)+0.668	Plant concentration equations from Bechtel-Jacobs 1998 and invertebrate concentration equations from Sample et al. 1999, as recommended in EPA 2005
			Copper: $B_{inverts}$=0.515*$Soil_j$	
			Lead: $\ln(B_{plants})$=(0.561*$\ln(Soil_j)$)-1.328	
			Lead: $\ln(B_{inverts})$=(0.807*$\ln(Soil_j)$)-0.218	
			Zinc: $\ln(B_{plants})$=(0.554*$\ln(Soil_j)$)+1.575	
			Zinc: $\ln(B_{inverts})$=(0.328*$\ln(Soil_j)$)+4.449	
N	total number of ingested prey types	unitless	2	EPA 1993 - American robin diet
P_i	fraction of food as prey $type_i$	unitless	Plants - 0.29	EPA 1993 - American robin diet
			Invertebrates - 0.71	

TABLE 4-1 Approach for Calculation of Estimated CPEC Intake for Modeled Receptor - American Robin

Swan Island OU2 Upland Facility Riverbank Soils

Equation (c) - CPEC intake from ingested soil

$$Intake_{soil} = AUF * (FIR * P_s * C_{js} * AF_{js})$$

Parameters - Equation (c):

Parameter	Description	Units	Value	Source/Notes
$Intake_{soil}$	Intake for contaminant (j) in soil	mg dw/kg bw-d	calculated	
C_{js}	Concentration of contaminant (j) in soil (s)	mg/kg dw	available data	All available site-wide sample data
FIR	Food intake rate	kg dw/kg bw-d	0.207	WDOE 2012 - food ingestion rate for American Robin
P_s	Proportion of total mass intake that is soil	kg soil/kg food	15.15%	EPA 2005 - average of 90th percentile values for avian granivore and avian insectivore [1]
AF_{js}	Bioavailability factor of contaminant (j) in soil	unitless	Zinc: 1 Lead: 0.5 Copper: 1	Bioavailability of zinc and copper from ingested food was conservatively assumed to be 100%. Bioavailability of lead from soils was assumed to be 50%; lead bioavailability from ingested food was assumed to be 100% [2]
P_i	Fraction of food as prey $type_i$	unitless	Plants - 0.29 Invertebrates - 0.71	EPA 1993 - American robin diet
AUF	Area use factor	unitless	1	Fraction of food derived from site; area use assumed to be 100%

Notes:

1 - Mourning dove and American woodcock are surrogate species for avian granivore and avian insectivore, respectively.

2- The assimilation efficiency or bioavailability of zinc and copper in ingested soils or biota was conservatively assumed to be 100%. This is a conservative estimate since the bioavailability of most metals is less, especially directly from incidentally ingested soils or soils in gut content of prey items. The exception is lead, where bioavailability from soils was assumed to be 50%; lead bioavailability from ingested food was assumed to be 100%. These assumptions are conservative in that actual lead bioavailability can be much lower, especially from inorganic forms of lead ore or mill tailings (Ruby et al. 1992), and lead iron oxides that tend to form in soils from soluble forms of lead (Suedel et al. 2006, Schoof 2003). Lead carbonates and organic forms have higher bioavailability (80%) (Suedel et al. 2006, Schoof 2003).

mg - milligram   dw - dry weight
kg - kilogram   bw - body weight
d - day

Sources:

Bechtel-Jacobs. 1998. Empirical Models for the Uptake of Inorganic Chemicals from Soil by Plants. Bechtel-Jacobs Company LLC, Oak Ridge, TN. BJC/OR-133.

Ruby, M.V., A. Davis, J.H. Kempton, J.W. Drexler, and P.D. Bergstrom. 1992. Lead Bioavailability: Dissolution Kinetics under Simulated Gastric Conditions. Environmental Science and Technology. 26:1242-1248.

Sample B.E., J.J. Beauchamp, R.A. Efroymson, G.W. Suter, II, and T.L. Ashwood. 1999. Literature-derived bioaccumulation models for earthworms: development and validation. Environmental Toxicology and Chemistry 18: 2110-2120.

Schoof, R.A. 2003. Guide for Incorporating Bioavailability Adjustments into Human Health and Ecological Risk Assessments at U. S. Department of Defense Facilities Part 1: Overview of Metals Bioavailability (Final).

Suedel , B.C., A. Nicholson, C.H. Day, J. Spicer II. 2006. The value of metals bioavailability and speciation in formation for ecological risk assessment in arid soils. Integrated Environmental Assessment and Management. 2:355-364.

United States Environmental Protection Agency (EPA). 1993. Wildlife Exposure Factors Handbook. EPA/600/R-93/1987a. Volumes I & II.

United States Environmental Protection Agency (EPA). 2005. Attachment 4-1, Guidance for Developing Ecological Soil-Screening Levels (Eco-SSLs), OSWER Directive 9285.7-55 (issued November 2003, revised February 2005).

TABLE 4-2 Ecological Benchmark Values (EBVs)

Swan Island OU2 Upland Facility Riverbank Soils

Modeled Receptor: American Robin

Analyte	Ecological Benchmark Value	Units	Type of Value	Source/Notes
Zinc	14.5	mg dw/kg bw-d	Rep/Gro NOAEL	Sample et al. 1996 - NOAEL based on avian toxicity data related to reproduction endpoints (food exposure duration for at least 10 weeks; zinc sulfate consumption by white leghorn hens; Stahl et al. 1990).
	55.0		Rep/Gro NOAEL	Geometric mean of NOAELs for reproduction/growth endpoints from studies of food consumption exposure over long duration (at least 10 weeks) (from Table 5-1 EPA 2007a)
	66.1		Rep/Gro NOAEL	"A geometric mean of the NOAEL values for reproduction and growth" (Figure 5-1 in EPA 2007a). This value is lower than the lowest bounded LOAEL for reproduction, growth, or survival.
	68.8		Mor NOAEL	NOAEL for mortality endpoint from one study of food consumption exposure over 10 weeks (Gibson et al 1986 cited in Table 5-1 EPA 2007a).
	87.1		Mor LOAEL	LOAEL for mortality endpoint from one study of food consumption exposure over 10 weeks (Gibson et al 1986 cited in Table 5-1 EPA 2007a).
	110.5		Rep/Gro LOAEL	Geometric mean of LOAELs for reproduction/growth endpoints from studies of food consumption exposure over long duration (from Table 5-1 EPA 2007)
	131		Rep/Gro LOAEL	Sample et al. 1996 - LOAEL based on avian toxicity data related to reproduction endpoints (food exposure duration for at least 10 weeks; zinc sulfate consumption by white leghorn hens; Stahl et al. 1990)
	144.8		Mor NOAEL	Geometric mean of NOAELs for mortality endpoint from studies of food consumption with an exposure duration of 4 weeks or more (from Table 5-1 EPA 2007)
	271		Mor NOAEL	Geometric mean of LOAELs for mortality endpoint from studies of food consumption with an exposure duration of 4 weeks or more (from Table 5-1 EPA 2007)
Lead	1.1	mg dw/kg bw-d	Rep/Gro NOAEL	Sample et al. 1996 - NOAEL based on avian toxicity data related to reproduction endpoints (food exposure duration for at least 10 weeks; lead acetate consumption by quail; Edens et al. 1976)
	1.6		Rep/Gro/Mor NOAEL	"Highest bounded NOAEL, lower than lowest bounded LOAEL for reproduction, growth, or survival" (Figure 5-1 in EPA 2005)
	10.9		Rep/Gro NOAEL	"Geometric mean of NOAELs for reproduction and growth" (Figure 5-1 in EPA 2005)
	11.3		Rep/Gro LOAEL	Sample et al. 1996 - LOAEL based on avian toxicity data related to reproduction endpoints (food exposure duration for at least 10 weeks; lead acetate consumption by quail; Edens et al. 1976)
	22.0		Mor NOAEL	Geometric mean of NOAELs for mortality endpoints from studies of food consumption exposure over long duration (from Table 5-1 EPA 2005); two studies.
Copper	4.05	mg dw/kg bw-d	Rep/Gro/Mor NOAEL	"Highest bounded NOAEL, lower than lowest bounded LOAEL for reproduction, growth, or survival" (Figure 5-1 in EPA 2007b)
	18.5		Rep/Gro NOAEL	"Geometric mean of NOAELs for reproduction and growth" (Figure 5-1 in EPA 2007b)
	20.8		Rep/Gro NOAEL	Geometric mean of NOAELs for reproduction/growth endpoints from studies of food consumption exposure over long duration (at least 10 weeks) (from Table 5-1 EPA 2007b)
	22		Mor NOAEL	Geometric mean of NOAELs for mortality endpoint from studies of food consumption with an exposure duration of 4 weeks or more (from Table 5-1 EPA 2007b)
	28.7		Rep/Gro LOAEL	Geometric mean of LOAELs for reproduction/growth endpoints from studies of food consumption exposure over long duration (at least 10 weeks) (from Table 5-1 EPA 2007b)
	42		Mor LOAEL	Geometric mean of LOAELs for mortality endpoint from studies of food consumption with an exposure duration of 4 weeks or more (from Table 5-1 EPA 2007b)
	68.4		Mor LOAEL	Mehring et al. 1960 - LOAEL mortality dose calculated from highest dose in study (1180 mg/Kg; food exposure duration for at least 10 weeks; copper oxide consumption by chicks), which resulted in 40% mortality. The dose was calculated using food ingestion rate and body weight information from EPA (2007b).

Notes:
EBV = Ecological Benchmark Value
mg dw/kg bw-d = milligrams of dry weight per kilogram of body weight per day
LOAEL = Lowest Observed Adverse Effects Level
NOAEL = No Observed Adverse Effects Level
Rep/Gro = Reproductive/Growth

TABLE 4-2 Ecological Benchmark Values (EBVs)

Swan Island OU2 Upland Facility Riverbank Soils

Mor = Mortality
na = not available

Sources:

Edens, F., W.E. Benton, S.J. Bursian, and G.W. Morgan. 1976. Effect of dietary lead on reproductive performance in Japanese quail, *Coturnix coturnix japonica*. Toxicol. Appl. Pharmacol. 38: 307-314.

Gibson, S. W., Stevenson, Mary H., and Jackson, N. 1986. Comparison of the effects of feeding diets supplemented with zinc oxide or zinc acetate on the performance and tissue mineral content of mature female fowls. Br. Poult. Sci. (1986) 27(3): 391-402 . Ref No. 6048.

Mehring, A.L., Jr., J.H. Brumbaugh, A.J. Sutherland, H.W. Titus. 1960. The tolerance of growing chickens for dietary copper. Poultry Science 39: 713-719.

Sample, B.E., D.M. Opresko, D.M., G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Risk Assessment Program, Health Sciences Research Division, Oak Ridge, TN. Publication ES/ER/TM-86-R3.

Stahl, J. L., J. L. Greger, and M. E. Cook. 1990. Breeding-hen and progeny performance when hens are fed excessive dietary zinc. Poult. Sci. 69: 259-263.

United States Environmental Protection Agency (EPA). 2007a. Ecological Soil Screening Levels for Zinc, Interim Final. OSWER Directive 9285.7-73 (June 2007).

United States Environmental Protection Agency (EPA). 2007b. Ecological Soil Screening Levels for Copper, Interim Final. OSWER Directive 9285.7-68 (Issued July 2006; Revised February 2007).

United States Environmental Protection Agency (EPA). 2005. Ecological Soil Screening Levels for Lead, Interim Final. OSWER Directive 9285.7-70 (March 2005).

TABLE 4-3 Exposure Calculation and Comparison to EBVs

Swan Island OU2 Upland Facility Riverbank Soils

Modeled Receptor: American robin, insectivorous bird

Toxicity quotient calculations

Constituent of Interest (COI)	EPC-90UCL (mg/kg)	EPC-90UCL Basis	Exposure Estimate (mg/kg BW/ day)	EBV (mg/kg BW/ day)	Type of EBV	Toxicity Quotient (TQ)
Zinc	536.9	Composite samples	156.01	14.5	Rep/Gro NOAEL	10.8
				55	Rep/Gro NOAEL	2.8
				66.1	Rep/Gro NOAEL	2.4
				68.8	Mor NOAEL	2.3
				87.1	Mor LOAEL	1.8
				110.5	Rep/Gro LOAEL	1.4
				131	Rep/Gro LOAEL	1.2
				144.8	Mor NOAEL	1.1
				271	Mor LOAEL	0.6
	296.1	Discrete samples	123.78	14.5	Rep/Gro NOAEL	8.5
				55.0	Rep/Gro NOAEL	2.2
				66.1	Rep/Gro NOAEL	1.9
				68.8	Mor NOAEL	1.8
				87.1	Mor LOAEL	1.4
				110.5	Rep/Gro LOAEL	1.1
				131.0	Rep/Gro LOAEL	0.9
				144.8	Mor NOAEL	0.9
				271	Mor LOAEL	0.5
	86.00	Background Concentration	79.02	14.5	Rep/Gro NOAEL	5.4
				55.0	Rep/Gro NOAEL	1.4
				66.1	Rep/Gro NOAEL	1.2
				68.8	Mor NOAEL	1.1
				87.1	Mor LOAEL	0.9
				110.5	Rep/Gro LOAEL	0.7
				131.0	Rep/Gro LOAEL	0.6
				144.8	Mor NOAEL	0.5
				271	Mor LOAEL	0.3

Constituent of Interest (COI)	EPC-90UCL (mg/kg)	EPC-90UCL Basis	Exposure Estimate (mg/kg BW/ day)	EBV (mg/kg BW/ day)	Type of EBV	Toxicity Quotient (TQ)
Lead	57.7	Composite samples	5.30	1.1	Rep/Gro NOAEL	4.7
				1.6	Rep/Gro/Mor NOAEL	3.3
				10.9	Rep/Gro NOAEL	0.5
				11.3	Rep/Gro LOAEL	0.47
				22.0	Mor NOAEL	0.24
	85.4	Discrete samples	7.37	1.1	Rep/Gro NOAEL	6.5
				1.6	Rep/Gro/Mor NOAEL	4.5
				10.9	Rep/Gro NOAEL	0.7
				11.3	Rep/Gro LOAEL	0.7
				22.0	Mor NOAEL	0.3
	17.00	Background Concentration	1.90	1.1	Rep/Gro NOAEL	1.7
				1.6	Rep/Gro/Mor NOAEL	1.2
				10.9	Rep/Gro NOAEL	0.2
				11.3	Rep/Gro LOAEL	0.2
				22.0	Mor NOAEL	0.1

TABLE 4-3 Exposure Calculation and Comparison to EBVs

Swan Island OU2 Upland Facility Riverbank Soils

Constituent of Interest (COI)	EPC-90UCL		Exposure Estimate	EBV	Type of EBV	Toxicity Quotient
	(mg/kg)	Basis	(mg/kg BW/ day)	(mg/kg BW/ day)		(TQ)
Copper	171.0	Composite samples	23.59	4.05	Rep/Gro/Mor NOAEL	5.8
				18.5	Rep/Gro NOAEL	1.3
				20.8	Rep/Gro NOAEL	1.1
				22	Mor NOAEL	1.1
				28.7	Rep/Gro LOAEL	0.8
				42	Mor LOAEL	0.6
				68.4	Mor LOAEL	0.3
	529.4	Discrete samples	73.04	4.05	Rep/Gro/Mor NOAEL	18.0
				18.5	Rep/Gro NOAEL	3.9
				20.8	Rep/Gro NOAEL	3.5
				22	Mor NOAEL	3.3
				28.7	Rep/Gro LOAEL	2.5
				42	Mor LOAEL	1.7
				68.4	Mor LOAEL	1.1
	36.0	Background Concentration	4.97	4.05	Rep/Gro/Mor NOAEL	1.2
				18.5	Rep/Gro NOAEL	0.3
				20.8	Rep/Gro NOAEL	0.2
				22	Mor NOAEL	0.2
				28.7	Rep/Gro LOAEL	0.2
				42	Mor LOAEL	0.1
				68.4	Mor LOAEL	0.1

Parameters

Exposure Parameters	Value	Unit
IRsoil	0.1515	kg soil/kg food
IRfood	0.207	kg dw/kg bw-d
Pplant	0	fraction
Pinverts	1	fraction
Soil bioavailability factor - zinc & copper	1	unitless
Soil bioavailability factor - lead	0.5	

Notes:
EPC = Exposure Point Concentration
EBV = Exposure Benchmark Value
TQ - Toxicity Quotient
90UCL = 90th upper confidence limit
Refer to Tables 4-1 and 4-2 for all exposure parameters, EBVs, and equations

Summary Table 5-1 for Population-level Probabilistic Risk Analyses

Swan Island OU2 Upland Facility

Modeled Receptor: American Robin, 100% Invertebrate Diet

Analyte	Ecological Benchmark Value (mg/kg bw/day)	Type of Value	Given the concentrations at the site, probability that more than 20% of the local population will experience Exposure>EBV *Acceptable Risk Level (ARL) for non T/E Species: probability <0.1* Based on Discrete Samples	Based on Composite Samples
Zinc	14.5	Rep/Gro NOAEL	1	1*
	66.1	Rep/Gro/Mor NOAEL	1	1
	55	Rep/Gro NOAEL	1	1
	68.8	Mor NOAEL	1	1
	87.1	Mor LOAEL	1	1
	110.5	Rep/Gro LOAEL	0.72	1
	131	Rep/Gro LOAEL	0.004	0.98
	144.8	Mor NOAEL	<0.00001	0.49
	271	Mor LOAEL	<0.00001	<0.00001
Lead	1.13	Rep/Gro NOAEL	1.00	1.00
	1.63	Rep/Gro/Mor NOAEL	1.00	1.00
	10.9	Rep/Gro NOAEL	0.03	<0.00001
	11.3	Rep/Gro LOAEL	0.02	<0.00001
	22	Mor NOAEL	<0.00001	<0.00001
Copper	4.05	Rep/Gro/Mor NOAEL	1.00	1.00
	18.5	Rep/Gro NOAEL	1.00	0.61
	20.8	Rep/Gro NOAEL	1.00	0.27
	22	Mor NOAEL	1.00	0.15
	28.7	Rep/Gro LOAEL	0.91	0.002
	42	Mor LOAEL	0.34	<0.00001
	68.4	Mor LOAEL	0.006	<0.00001

Notes:

EBV = Ecological Benchmark Value

mg dw/kg bw-d = milligrams of dry weight per kilogram of body weight per day

LOAEL = Lowest Observed Adverse Effects Level

NOAEL = No Observed Adverse Effects Level

Rep/Gro = Reproductive/Growth

Mor = Mortality

na = not available

Acceptable risk level (ARL)[OAR 340-122-115(6)] for populations of ecological receptors is a 10% or less chance that 20% or more of the total local population would receive an exposure greater than the EBV.

Values that exceed 10% are bold-italicized.

Refer to Appendix F for all risk calculation worksheets

* = although the actual probability was 0 due to mathematical circumstances of the binomial distribution function, the probability is better represented as 1.

FIGURES

S:\GIS\ARCPRJ2\010116\PLT\SIUF_OU2_ERAFNL\SIUFOU2_ERAFNL_FIG1-1_SITE.MXD

Legend

- Riverbank Sampling Locations

Discrete samples indicated by: ⊙

Composite samples indicated by: +

SIUF OU Boundaries (approx.)
- OU1
- OU2
- OU4

Outfalls/Storm Water Pipes
- Outfall - abandoned
- Outfall - active
- Outfall - inactive
- Storm water pipe (end) - abandoned July 2006

Notes:
- OU = Operable Unit; ERA = Ecological risk assessment
- Composite samples were created by combining discrete samples - but these samples are presented as separate points on this figure, so as to be able to present results for those samples.
- Aerial photography - 2009
- Boundaries and sampling locations are approximate; based on latest information provided by Ash Creek Associates.

N

Feet

0 100 200

Swan Island Upland Facility - Operable Unit 2

Willamette River

SWAN ISLAND UPLAND FACILITY

OU2 - FINAL LEVEL II SCREENING ERA

FIGURE 1-1

SITE OVERVIEW AND SAMPLING LOCATIONS

PRJ: 007-013	FEB 24, 2012	
REV: 0	BY: RCR	CHK: MCL

FORMATION ENVIRONMENTAL

Legend

Zinc Exceedances (mg/kg)
- <=86 (Background)
- 86-120 (1x Invert SLV)
- 120-160 (1x Plant SLV)
- 160-600 (5x Invert SLV)
- 600-800 (5x Plant SLV)
- >800
- Other sampling locations

Discrete samples indicated by: ⊙

Composite samples indicated by: +

SIUF OU Boundaries (approx.)
- OU1
- OU2
- OU4

Outfalls/Storm Water Pipes
- Outfall - abandoned
- Outfall - active
- Outfall - inactive
- Storm water pipe (end) - abandoned July 2006

Oregon DEQ-Approved Level II Screening Level Values (SLVs)* - Zinc:
Plant - 160 mg/kg
Invertebrate -120 mg/kg
Bird - 46 mg/kg
Mammal - 79 mg/kg
*Refer to Table 3-1 for background and screening level source information.

Notes:
- OU = Operable Unit; ERA = Ecological risk assessment
- Composite samples were created by combining discrete samples - but these samples are presented as separate points on this figure, so as to be able to present results for those samples.
- Aerial photography - 2009
- Boundaries and sampling locations are approximate; based on latest information provided by Ash Creek Associates.
- Background (bkg) values from Oregon DEQ Toxicology Workgroup Memorandum to DEQ Cleanup Project Managers regarding "Default background concentrations for metals". October 28, 2002.

N

Feet
0 100 200

SWAN ISLAND UPLAND FACILITY
OU2 - FINAL LEVEL II SCREENING ERA

FIGURE 4-1

PLANT AND INVERTEBRATE SCREENING LEVEL EXCEEDANCES - ZINC

PRJ: 007-013	JUN 28, 2012
REV: 0	BY: EJS CHK: MCL

FORMATION ENVIRONMENTAL

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Legend

Copper Exceedances (mg/kg)
- <= 36 (Background)
- 36-70 (1x Plant SLV)
- 70-80 (1x Invert SLV)
- 80-350 (5x Plant SLV)
- 350-400 (5x Invert SLV)
- >400
- Other sampling locations

Discrete samples indicated by: ⊙

Composite samples indicated by: +

SIUF OU Boundaries (approx.)
- OU1
- OU2
- OU4

Outfalls/Storm Water Pipes
- Outfall - abandoned
- Outfall - active
- Outfall - inactive
- Storm water pipe (end) - abandoned July 2006

Oregon DEQ-Approved Level II Screening Level Values (SLVs)* - Copper:
- Plant - 70 mg/kg
- Invertebrate - 80 mg/kg
- Bird - 28 mg/kg
- Mammal - 49 mg/kg

*Refer to Table 3-1 for background and screening level source information.

Notes:
- OU = Operable Unit; ERA = Ecological risk assessment
- Composite samples were created by combining discrete samples - but these samples are presented as separate points on this figure, so as to be able to present results for those samples.
- Aerial photography - 2009
- Boundaries and sampling locations are approximate; based on latest information provided by Ash Creek Associates.
- Background (bkg) values from Oregon DEQ Toxicology Workgroup Memorandum to DEQ Cleanup Project Managers regarding "Default background concentrations for metals". October 28, 2002.

N

Feet

0 100 200

SWAN ISLAND UPLAND FACILITY
OU2 - FINAL LEVEL II SCREENING ERA

FIGURE 4-2

PLANT AND INVERTEBRATE SCREENING LEVEL EXCEEDANCES - COPPER

PRJ: 007-013	JUN 28, 2012
REV: 0	BY: EJS CHK: MCL

FORMATION ENVIRONMENTAL

APPENDIX A
Level I Scoping Ecological Risk Assessment, Swan Island Upland Facility, Operable Unit 2 (February 2006), with Subsequent Letters and Attachments

Level I Scoping Ecological Risk Assessment
Portland Shipyard, Operable Unit 2
Swan Island Upland Facility

February 2006

Prepared for:

Bridgewater Group, Inc.
4500 SW Kruse Way
Suite 110
Lake Oswego, OR 97035

On Behalf of:

Port of Portland
121 NW Everett
Portland, OR 97209

Prepared by:

NEWFIELDS
4720 Walnut Street, Suite 200
Boulder, Colorado 80301

TABLE OF CONTENTS

Page

1.0 Introduction 1
1.1 Site Location 1
1.2 Site History 1
1.3 Current Site Use 3

2.0 Ecological Features and Sensitive Environments 3
2.1 Threatened and Endangered Species 4
2.2 Facility Visit Summary 4

3.0 Constituents of Interest (COIs) 4
3.1 Observed Impacts 5
3.2 Exposure Pathways 5

4.0 Recommendations 6

5.0 References 7

LIST OF FIGURES

Figure	Title
1	OU2 Boundary

LIST OF ATTACHMENTS

Attachment	Title
1	Ecological Scoping Checklist
2	Evaluation of Receptor-Pathway Interactions
3	Oregon Natural Heritage Program Species of Special Interest
4	Photo Log

1.0 INTRODUCTION

This Level I Scoping Ecological Risk Assessment (ERA) for Operable Unit 2 (OU2) of the Swan Island Upland Facility (Facility) was based upon the process prescribed by the Oregon Department of Environmental Quality (DEQ) in the Guidance for Ecological Risk Assessment: Levels I, II, III, IV (DEQ, 1998 with updates through 2001). The guidance describes a sequence for conducting ERAs, beginning with Level I Scoping. The purpose of the Level I Scoping ERA is to provide a conservative qualitative determination of whether there is reason to believe that ecological receptors and/or exposure pathways are present at OU2. If existing information indicates that site conditions will not result in exposure of ecological receptors, then no further risk analysis is necessary. If hazardous substances and exposure pathways are present, the process proceeds to a Level II screening analysis to determine if hazardous substances are present at potentially ecotoxic concentrations and, if so, what additional risk analysis may be necessary to make risk management decisions for a facility.

DEQ guidance for the Level I ERA deliverable was used as the basis for organizing this ERA. The Level I deliverable also includes a checklist for summarizing OU2 features based on a site visit, and a form for evaluating potential receptor-pathway interactions. These forms are included as Attachments 1 and 2 to this ERA.

The following sections summarize the location, history, current uses and physical features of OU2 relevant to the Scoping ERA.

1.1 Site Location

OU2 is located on Swan Island off the east bank of the Willamette River between approximately River Miles 8.8 and 9.2, Portland, Oregon (Figure 1). OU2 is comprised of 37 acres on the Willamette River on the southwest side of Swan Island and is owned by the Port of Portland (Port).

1.2 Site History

Swan island was originally a periodically flooded sand bar and marsh with the main channel of the Willamette River between the island and Mocks Bottom to the east. The Willamette River on the west side of the island was too shallow for ship navigation. In 1923, the main channel of the Willamette River was relocated from the east side of the island to the west side of the island. A causeway was built in the east channel from the mainland to the island, and the south end of Mocks Bottom was raised, making a peninsula of the island and creating a still-water lagoon of the east channel.

Between 1926 and 1942, OU2 was part of the first Portland municipal airport that was constructed on Swan Island after the island was filled and the main channel of the Willamette River was relocated. The only airport operation that was located on OU2 was a paved runway.

Between the early 1940's and 1978, OU2 was primarily open, graded soil with railroad spurs used for material receiving and storage. A salvage building was located in the west-central portion of the area. No over-water or near-shore shipyard or other industrial activities were conducted at OU2 during this timeframe.

In 1978, OU2 was used as the staging and pre-cast concrete construction site for the shipyard ballast water treatment plant. The northwest portion of OU2 was subsequently paved and used as the main parking lot for the shipyard.

From 1986 to 1990, the central and eastern portions of OU2 were used by Atlantic Richfield Company (ARCO) for the construction of modular units used for oil processing on Alaska's North Slope. Fabrication, finish painting and the application of fire retardant were conducted on concrete pads in the center of the area, with material storage, administrative modular trailers, and equipment stored around the perimeter of the area. A portable fire safety shed was constructed on the west side of the area. The shed is still present and used as the Shipyard University. Building 83 was constructed as part of the ARCO modular fabrication project. This building served as a general shop and vehicle maintenance repair area. Petroleum products were stored in drums and in small aboveground storage tanks south of Building 83. According to the Port, ARCO installed two pipes to drain upland areas where water tended to accumulate during periods of high rainfall. The pipes were capped when ARCO ceased its operations in 1990. Thus, both pipes are past potential migration pathways, but are not current migration pathways.

After 1990, the central and southeast portions of OU2 were used for outdoor storage of equipment, steel, cable drums, and empty portable tanks and totes until 2000 when Cascade General purchased the shipyard. During this timeframe, wood recycling also occurred in this area; OU2 was not used to store or manage wastes (solid or hazardous) associated with shipyard operations.

After 2000, the central portion of OU2 was temporarily used by a Port tenant to store sand, gravel and aggregate. The eastern portion of OU2 remained unused until several years ago when the Port leased this portion of OU2 to Freightliner to park new trucks and trailers.

No over-water or near-shore shipyard or other industrial activities were ever conducted at OU2 between the early 1940's and today, except for the hoteling (i.e., temporary moorage) of ships at Berth 315. Berth 315 was constructed in the mid-1980's. It consists of a concrete walkway that is accessed by an unpaved road from the Berth 314 area. Berth 315 is located on Port-owned riverbed and the Port allows vessels to be moored there under a management agreement with Shipyard Commerce Center LLC.

1.3 Current Site Use

The asphalt-paved northwest portion of OU2 (8 acres) is a parking lot for shipyard workers (Figure 1). The central portion of OU2 (approximately 20 acres) is currently vacant. The southeast portion of OU2 (approximately 9 acres) is currently leased to Freightliner to park new trucks and trailers. A metal walkway extends into Berth 315 from the upland area. However, Berth 315 is not currently used.

OU2 is surrounded by similarly developed tracts and no significant upland ecological resources are present within 1 mile of the OU2. No change in conformation is anticipated.

2.0 ECOLOGICAL FEATURES AND SENSITIVE ENVIRONMENTS

The portions of OU2 that are northeast (i.e., inland) of the Willamette River bank are largely devoid of vegetation being composed of asphalt-covered parking lot, or gravel-covered work areas with concrete slabs. Vegetation on most of the property is strictly ruderal, with sparse vegetation consisting of opportunistic or weedy annual species, but more commonly containing no vegetation at all (Figure 1). The surface soil conditions and use in these areas prevent more long-lived plant species from establishing and creating an early successional native habitat type. The unpaved portions of OU2 do not and will not provide suitable habitat for ecological receptors because of former, current, and reasonably likely future uses of the property (i.e., truck and trailer parking and aggregate processing).

The riverbank at OU2 is composed of fill material with rock, concrete debris and rip-rap. Above the high water line, willows, Himalayan blackberry, and weedy vegetation have established. A variety of willow species (e.g., Pacific, Columbia River, and Piper’s Willow) and black cottonwood saplings have become established on the beach. The vegetated area on the river bank (approximately 5 acres) is narrow (approximately 80 feet wide) and is disconnected from riparian upland areas. The riverbank does not have observable areas of erosion or bank sloughing.

A Greenway Review, as required under City Code, is currently not required for OU2. As an alternative to compliance with City Code Section 33.440.210 (Greenway Setback requirements), in 1996-97 the Port secured approval of a riverbank development mitigation plan (the Plan) under City Code 33.585.050(B) for the Swan Island Plan District. The Plan was approved by Hearings Officer decision LUR 96-01086 IM AD, effective August 2, 1997. Pursuant to the approved Plan, development projects within the Swan Island Plan District are exempt from Greenway review requirements through August 1, 2007.

The Willamette River near OU2 provides habitat for aquatic and semi-aquatic species. The river is identified as a sensitive environment in OAR 340-122-0115. There are no wetlands or permanent waterbodies on OU2.

According to a study conducted by the Oregon Department of Fish and Wildlife (ODFW) (2005), the types of habitat in the Willamette River near OU2 may support populations of resident and migratory fish species, including juvenile salmonids. However, ODFW did not conduct surveys at locations along the OU2 shoreline.

The Lower Willamette Group (LWG) collected crayfish, largescale sucker, sculpin, peamouth, and small mouth bass within one mile, but no biota sampling was attempted near the shore of OU2. The LWG collected sediment samples offshore of OU2 and a beach sediment sample from the beaches adjacent to OU2. The resulting data will be used in the Portland Harbor RI/FS.

2.1 Threatened and Endangered Species

A listing of threatened and endangered species potentially present in the area was provided by the Oregon Natural Heritage Program (ONHP). The list includes historical presence of federal and state-listed species. Attachment 3 to this ERA summarizes the species listed by the ONHP. A copy of the letter from the ONHP identifying the species is also included in Attachment 3.

2.2 Facility Visit Summary

A facility visit was conducted by the project lead ecological risk assessor on October 31, 2005. The ecological features are described based on the facility visit, aerial photographs, and general Facility knowledge. Photographs taken from the Facility visit are presented in Attachment 4 to this ERA, along with an aerial photo of OU2.

3.0 CONSTITUENTS OF INTEREST (COIs)

Sampling of surface and subsurface soils was conducted at OU2 prior to the sale of the Portland Shipyard to Cascade General, and during the Phase IA and 1B Portland Shipyard Remedial Investigation. As a result of this sampling, metals (especially arsenic, cadmium, copper, lead and zinc), total petroleum hydrocarbons (TPH); polychlorinated biphenyls (PCBs); and polynuclear aromatic hydrocarbons (PAHs) were detected in surface and subsurface soils. Initial screening of the analytical results lead to the identification of a hotspot for arsenic in the undeveloped south-central part of OU2 (Figure 1). Site topography prevents soils in this area from being transported to the river via runoff. In addition, the capping of the nearby drain pipe after ARCO ceased its operations prevents soils in this area from being transported to the river bank.

Several COIs were detected in soils near the south end of OU2, near the property boundary. Some of the detections were near a storm drain and catchment.

3.1 Observed Impacts

No ecotoxicological impacts on ecological receptors were observed at OU2. As indicated above, there are no ecological resources (habitat or food sources) located within the working area of OU2. No receptors other than waterfowl and other birds associated with the river were observed at OU2.

3.2 Exposure Pathways

As noted above, most of the upland portion of OU2 is covered by asphalt or barren ground and does not represent an ecological resource. Some areas along property lines contain ruderal vegetation, but the vegetated area of OU2 is less than 5%. As a result, wildlife are unlikely to feed at OU2 and ecological exposures to surface soils at OU2 would be limited to occasional contact by birds or mammals that may cross OU2.

The riverbank areas may be habitat for small birds, mammals, and may be visited by species such as beaver. However, no Facility-related operations ever occurred over water or along the rivershore, and the upland portions of OU2 do not drain and have not drained to the riverbank, except for the two locations where ARCO installed pipes to drain upland areas where water tends to accumulate during periods of high rainfall. These pipes were capped when ARCO ceased it operations in 1990. Therefore, exposure of ecological receptors to site-specific contaminants on the riverbank or shoreline areas is unlikely.

Erodible soil particles are unlikely to have entered the catch basins located in the northwestern portion of OU2 because they only capture runoff from the asphalt-paved main parking lot. Erodible soil particles could have entered the one catch basin at the far south end of OU2 and could have been transported to the river if not deposited in the catch basin. If contaminated soils were transported to the river at this location, aquatic organisms in the river could be exposed to site contaminants. However, transport of soils from OU2, and subsequent exposure of aquatic resources has not been confirmed. In addition, the ERA associated with the Portland Harbor RI/FS is evaluating ecological risks to aquatic organisms in the river, and ecological receptors such as shorebirds that use beach areas.

Arsenic and some organic compounds have been detected in shallow groundwater at OU2. No seeps are apparent on the riverbank at OU2, nor is there evidence of groundwater transport to the river in this location. However, discharge of shallow groundwater could result in transport of contaminants in shallow groundwater to the Willamette River.

A general evaluation of potential exposure pathways is provided in the Level I checklists shown in Attachments 1 and 2.

4.0 RECOMMENDATIONS

No significant ecological resources are present in the upland areas at OU2. The riverbank area is densely vegetated with ground cover of grasses and shrubs, including introduced species such as Himalayan blackberry. Since the site mostly drains to the site interior, there are no current overland runoff transport pathways from the upland soils to the riverbank or to the beach and river. There also does not appear to be any prominent areas of erodbile soils on the riverbank. However, the two small pipes that were historically used to drain localized areas where storm water accumulated during periods of high rainfall drain to the riverbank and may have periodically transported site particulates and stormwater offsite. The only other potential pathway for transport of erodible soils to the river is via the storm drain at the far south end of OU2. The beach area and river adjacent to OU2 are being evaluated as part of the Portland Harbor RI/FS ERA. As a result, there does not appear to be completed exposure pathways for terrestrial plant and animal populations, except potentially where the two pipelines discharge onto the riverbank. The Port recently completed a removal action for surface soil containing arsenic above the hot spot level from an area east of the inlet for the southernmost pipe.

The Port has proposed additional soil sampling at the site to confirm post-removal metal concentrations in the hotspot area, and to characterize soils downgradient of the southernmost drainpipe noted above, to determine if contaminated site soils have been transported to the riverbank and/or beach. These data will be used along with previously collected OU2 soil and groundwater data collected and the beach sample collected by the Lower Willamette Group adjacent to OU2, to conduct a Level II Screening assessment based on appropriate ecotoxicological screening level values (SLVs) established by DEQ (2001), and appropriate screening values in the Joint Source Control Strategy (DEQ/EPA 2005).

5.0 REFERENCES

Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final April 1998, updated May 2001.

Oregon Department of Environmental Quality (DEQ) and U.S. Environmental Protection Agency (EPA). 2005. Portland Harbor Joint Source Control Strategy, Final, December 21, 2005. Updates at http://www.deq.state.or.us/nwr/Portland Harbor/jscs.

Bridgewater Group, Inc. 2005. Operable Unit 2 Removal Action Work Plan – Swan Island Upland Facility. Prepared on behalf of Port of Portland for Oregon Department of Environmental Quality. February 23, 2005.

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Port of Portland

Swan Island Upland Facility, OU2

FIGURE 1

OU2 Boundary

PRJ: 0219-003-900	DATE: JAN 24, 2006	
REV: 0	BY: MCP	CHK: MCL

NEWFIELDS

ATTACHMENT 1
Ecological Scoping Checklist for the
Swan Island Upland Facility (OU2)

Site Name	Swan Island Upland Facility (OU2)
Date of Site Visit	October 31, 2005
Site Location	5413 North Channel Avenue, Portland, OR
Site Visit Conducted by	Mark Lewis, NewFields Boulder

Part 1

CONTAMINANTS OF INTEREST **Types, Classes, Or Specific Hazardous Substances ‡** **Known Or Suspected**	**Onsite**	**Adjacent to or in locality of the facility †**
PAHs	X	
PCBs (Aroclor 1254)	X	
Metals (arsenic, cadmium, copper, lead and zinc)	X	

‡ As defined by OAR 340-122-115(30) † As defined by OAR 340-122-115(34)

Part 2

OBSERVED IMPACTS ASSOCIATED WITH THE SITE	**Finding**
Onsite vegetation (**N**one, **L**imited, **E**xtensive)	Limited
Vegetation in the locality of the site (**N**one, **L**imited, **E**xtensive)	Limited
Onsite wildlife such as macroinvertebrates, reptiles, amphibians, birds, mammals, other (**N**one, **L**imited, **E**xtensive)	None
Wildlife such as macroinvertebrates, reptiles, amphibians, birds, mammals, other in the locality of the site (**N**one, **L**imited, **E**xtensive)	Limited
Other readily observable impacts (**N**one, **D**iscuss below)	None
Discussion: Eight (8) acres of OU2 are developed and paved with no on-site habitat to be affected. Twenty nine (29) acres of OU2 are unpaved and undeveloped. However, the unpaved portions only contain ruderal vegetation consisting of opportunistic or weedy annual species. Riverbank below top-of-bank is vegetated with shrubs, grasses, and forbs.	

ATTACHMENT 1
Ecological Scoping Checklist (cont'd)

Part 3

SPECIFIC EVALUATION OF ECOLOGICAL RECEPTORS / HABITAT	Finding
Terrestrial – Wooded	
Percentage of site that is wooded	0%
Dominant vegetation type (**E**vergreen, **D**eciduous, **M**ixed)	N/A
Prominent tree size at breast height, i.e., four feet (<6", 6" to 12", >12")	N/A
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds, **M**ammals, **O**ther)	N/A
Terrestrial - Scrub/Shrub/Grasses	
Percentage of site that is scrub/shrub – NOTE: Riverbank area only	14%
Dominant vegetation type (**Sc**rub, **Sh**rub, **G**rasses, **O**ther)	Sh & G
Prominent height of vegetation (<2', 2' to 5', >5')	2'-5' on riverbank
Density of vegetation (**D**ense, **P**atchy, **S**parse)	S or absent on upland; D on riverbank
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds, **M**ammals, **O**ther)	None observed
Terrestrial – Ruderal	
Percentage of site that is ruderal	>5%
Dominant vegetation type (**L**andscaped, **A**griculture, **B**are ground)	**B and asphalt**
Prominent height of vegetation (0', >0' to <2', 2' to 5', >5')	<2'
Density of vegetation (**D**ense, **P**atchy, **S**parse)	**S or absent on upland; D on riverbank**
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds, **M**ammals, **O**ther)	None observed
Aquatic - Non-flowing (lentic)	
Percentage of site that is covered by lakes or ponds	0%
Type of water bodies (**L**akes, **P**onds, **V**ernal pools, **I**mpoundments, **Lag**oon, **R**eservoir, **C**anal)	N/A
Size (acres), average depth (feet), trophic status of water bodies	N/A
Source water (**R**iver, **St**ream, **G**roundwater, **I**ndustrial discharge, **Su**rface water runoff)	N/A
Water discharge point (**N**one, **R**iver, **St**ream, **G**roundwater, **W**etlands impoundment)	N/A
Nature of bottom (**M**uddy, **R**ocky, **S**and, **C**oncrete, **O**ther)	N/A
Vegetation present (**S**ubmerged, **E**mergent, **F**loating)	N/A
Obvious wetlands present (**Y**es / **N**o)	N/A
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds, **M**ammals, **O**ther)	N/A

Aquatic - Flowing (lotic)	
Percentage of site that is covered by rivers, streams (brooks, creeks), intermittent streams, dry wash, arroyo, ditches, or channel waterway –**No permanent waterbody other than portion of Willamette River adjacent to upland.**	0%
Type of water bodies (**R**ivers, **S**treams, **I**ntermittent Streams, **D**ry wash, **A**rroyo, **D**itches, **C**hannel waterway)	N/A
Size (acres), average depth (feet), approximate flow rate (cfs) of water bodies	N/A
Bank environment (cover: **V**egetated, **B**are / slope: **S**teep, **G**radual / height (in feet))	N/A
Source water (**R**iver, **St**ream, **G**roundwater, **I**ndustrial discharge, **Su**rface water runoff)	N/A
Tidal influence (**Y**es / **N**o)	N/A
Water discharge point (**N**one, **R**iver, **St**ream, **G**roundwater, **W**etlands impoundment)	N/A
Nature of bottom (**M**uddy, **R**ocky, **S**and, **C**oncrete, **O**ther)	N/A
Vegetation present (**S**ubmerged, **E**mergent, **F**loating)	N/A
Obvious wetlands present (**Y**es / **N**o)	N/A
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds,	N/A
Mammals, **O**ther)	N/A
Aquatic – Wetlands	
Obvious or designated wetlands present (**Y**es / **N**o)	No
Wetlands suspected as site is/has (**A**djacent to water body, in **F**loodplain, **S**tanding water, **D**ark wet soils, **M**ud cracks, **D**ebris line, **W**ater marks)	N/A
Vegetation present (**S**ubmerged, **E**mergent, **S**crub/shrub, **W**ooded)	N/A
Size (acres) and depth (feet) of suspected wetlands	N/A
Source water (**R**iver, **St**ream, **G**roundwater, **I**ndustrial discharge, **Su**rface water runoff)	N/A
Water discharge point (**N**one, **R**iver, **St**ream, **G**roundwater, **I**mpoundment)	N/A
Tidal influence (**Y**es / **N**o)	N/A
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds, **M**ammals, **O**ther)	N/A

ECOLOGICALLY IMPORTANT SPECIES / HABITATS OBSERVED
Industrial development along the river significantly limits the habitat potential of OU2. No ecologically important habitats are observed at OU2. Upland inland from top-of-bank will continue to be use for industrial or stockpiling purposes. Steepness, rip-rap, debris, and blackberry on the banks limit value of riparian habitat.

ATTACHMENT 2
Evaluation of Receptor-Pathway Interactions

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in surface waters? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via surface water?**		N	
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in surface waters. • Ability of hazardous substances to migrate to surface waters. • Terrestrial organisms may be dermally exposed to water-borne contaminants as a result of wading or swimming in contaminated waters. Aquatic receptors may be exposed through osmotic exchange, respiration or ventilation of surface waters. • Contaminants may be taken-up by terrestrial plants whose roots are in contact with surface waters. • Terrestrial receptors may ingest water-borne contaminants if contaminated surface waters are used as a drinking water source.			
Are hazardous substances present or potentially present in groundwater? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via groundwater?**	X		
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in groundwater. • Ability of hazardous substances to migrate to groundwater. • Potential for hazardous substances to migrate via groundwater and discharge into habitats and/or surface waters. • Contaminants may be taken-up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (1m depth). • Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.			

“Y” = yes; “N” = No, “U” = Unknown (counts as a “Y”)

ATTACHMENT 2
Evaluation of Receptor-Pathway Interactions (cont'd)

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in sediments? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via contact with sediments?** ***NOTE: Soils and catchment sediments could be transported to the Willamette River during rainfall events via the storm drain on the south end of the site and historically, through drainpipes near the center of the site. However, there are no permanent on-site water bodies that produce sediments.***			X
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in sediment. • Ability of hazardous substances to leach or erode from surface soils and be carried into sediment via surface runoff. • Potential for contaminated groundwater to upwell through, and deposit contaminants in, sediments. • If sediments are present in an area that is only periodically inundated with water, terrestrial species may be dermally exposed during dry periods. Aquatic receptors may be directly exposed to sediments or may be exposed through osmotic exchange, respiration or ventilation of sediment pore waters. • Terrestrial plants may be exposed to sediment in an area that is only periodically inundated with water. • If sediments are present in an area that is only periodically inundated with water, terrestrial species may have direct access to sediments for the purposes of incidental ingestion. Aquatic receptors may regularly or incidentally ingest sediment while foraging.			
Are hazardous substances present or potentially present in prey or food items of ecologically important receptors? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via consumption of food items?**		X	
When answering the above questions, consider the following: • Higher trophic level terrestrial and aquatic consumers and predators may be exposed through consumption of contaminated food sources. • In general, organic contaminants with log Kow > 3.5 may accumulate in terrestrial mammals and those with a log Kow > 5 may accumulate in aquatic vertebrates.			

"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")

ATTACHMENT 2
Evaluation of Receptor-Pathway Interactions (cont'd)

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in surficial soils? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via incidental ingestion of or dermal contact with surficial soils?** ***NOTE: Current data on hazardous substances in soils suggest that receptors would not be exposed because of lack of habitat in the working areas of the site. Further sampling of beaches downgradient of drain pipe has been proposed to confirm this for downgradient areas.***		X	
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in surficial (1m depth) soils. • Ability of hazardous substances to migrate to surficial soils. • Significant exposure via dermal contact would generally be limited to organic contaminants which are lipophilic and can cross epidermal barriers. • Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces by rain striking contaminated soils (i.e., rain splash). • Contaminants in bulk soil may partition into soil solution, making them available to roots. Incidental ingestion of contaminated soil could occur while animals grub for food resident in the soil, feed on plant matter covered with contaminated soil or while grooming themselves clean of soil.			
Are hazardous substances present or potentially present in soils? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via vapors or fugitive dust carried in surface air or confined in burrows?**		X	
When answering the above questions, consider the following: • Volatility of the hazardous substance (volatile chemicals generally have Henry's Law constant > 10-5 atm-m3/mol and molecular weight < 200 g/mol). • Exposure via inhalation is most important to organisms that burrow in contaminated soils, given the limited amounts of air present to dilute vapors and an absence of air movement to disperse gases. • Exposure via inhalation of fugitive dust is particularly applicable to ground-dwelling species that could be exposed to dust disturbed by their foraging or burrowing activities or by wind movement. • Foliar uptake of organic vapors would be limited to those contaminants with relatively high vapor pressures. • Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces.			

"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")

Attachment 3

Oregon Biodiversity Information Center Species of Special Interest
Swan Island Upland Facility (OU2)

Common Name	Scientific Name	Federal Status	State Status
Plants			
Tall bugbane	Cimicifuga elata	-	C
Fish			
Green sturgeon	Acipenser medirostris	SOC	-
Steelhead (Lower Columbia River ESU, winter run)	Oncorhynchus mykiss pop. 27	LT	SC
Chinook salmon (Lower Columbia River ESU, spring run)	Oncorhynchus tshawytscha pop. 21	LT	SC
Chinook salmon (Lower Columbia River ESU, fall run)	Oncorhynchus tshawytscha pop. 22	LT	SC
Coho salmon (Lower Columbia River/SW Washington Coast ESU)	Oncorhynchus kisutch pop. 1	LT (PT)	LE
Birds			
American peregrine falcon	Falco peregrinus annatum	-	SV (LE)
Yellow-billed cuckoo	Coccyzus americanus	C	SC
Tricolored blackbird	Agelaius tricolor	SOC	- (SP)
Reptiles/Amphibians			
Painted turtle	Chrysemys picta belli	-	SC
Mammals			
Townsend's big-eared bat	Corynorhinus townsendii	SOC	SC

Notes:

Highlighted cells = updated listings with the most current status listed first. Status in parentheses is the old 2006 status of the species.

LE - listed endangered

E - endangered

SC - sensitive, critical

C - Candidate for Listing as Threatened or Endangered

SP - sensitive-peripheral

SOC - species of concern

LT - listed threatened

OREGON NATURAL HERITAGE INFORMATION CENTER

Oregon State University
Institute for Natural Resources
1322 SE Morrison Street
Portland, Oregon 97214-2423
503.731.3070
http://oregonstate.edu/ornhic

October 28, 2005

Julie Zadel
NewFields
4720 Walnut Street, Suite 200
Boulder, CO 80301

Dear Ms. Zadel:

Thank you for requesting information from the Oregon Natural Heritage Information Center (ORNHIC). We have conducted a data system search for rare, threatened and endangered plant and animal records for your Swan Island Upland Facility OU2 Project in Township 1 North, Range 1 East, Section 20, W.M.

Sixteen (16) records were noted within a two-mile radius of your project and are included on the enclosed computer printout. A key to the fields is also included.

Please remember that the lack of rare element information from a given area does not mean that there are no significant elements there, only that there is no information known to us from the site. To assure that there are no important elements present, you should inventory the site, at the appropriate season.

This data is confidential and for the specific purposes of your project and is **not to be distributed.**

If you need additional information or have any questions, please do not hesitate to contact me.

Sincerely,

Cliff Alton
Conservation Information Assistant

encl.: invoice (H-102805-CWA6)
computer printout and data key

Scientific Name: ***Falco peregrinus anatum***
Common Name: **American peregrine falcon**
Federal Status: GRANK: G4T3 NHP List: 2 Category: Vertebrate Animal
State Status: LE SRANK: S2B HP Track: Y ELCODE: ABNKD06071
EO ID: 18668 First Obs: 1994 Last Obs: 2003 Confirmed:
Directions: Sensitive Data - contact ORNHIC for more information

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Multnomah	WV	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
001N001E	27		45122-E6	Portland	1709001202 - SCAPPOOSE CREEK/MULTNOMAH CHANNEL
001N001E	28				

Owner Name/Type	Owner Comments	Managed Area Name
STATE	STATE HIGHWAY DIVISION	STATE HIGHWAY MAINTENANCE DIST 2B

EO Type: BREEDING SITE Minimum Elev.(m): 15
EO Data: Documented nesting site. See annual observations.

Annual Observations
- 2003 - 3 young captured and released, 1 fledged
- 2002 - ORNHIC has not received data yet
- 2001 - ORNHIC has not received data yet
- 2000 - ORNHIC has not received data yet
- 1999 - ORNHIC has not received data yet
- 1998 - active nest, 4 young
- 1997 - active nest, 2 young
- 1996 - active nest, 2 young
- 1995 - active nest, 1 young
- 1994 - active nest, 1 young
- 1993 - occupied nest, inactive

EO Comments:
Protection:
Management:
General: Site OE-026 and USFWS site 8. 2003: Human intervention affected outcome, 3 young captured and released, 1 fledged.

Scientific Name: ***Coccyzus americanus***
Common Name: **Yellow-billed cuckoo**
Federal Status: C GRANK: G5 NHP List: 2-ex Category: Vertebrate Animal
State Status: SC SRANK: SHB HP Track: Y ELCODE: ABNRB02020
EO ID: 17539 First Obs: 1923-06-08 Last Obs: 1985 Confirmed:
Directions: PORTLAND-ALONG THE COLUMBIA RIVER FROM THE MOUTH OF THE WILLAMETTE N TO WHAT IS NOW THE PORTLAND AIRPORT

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Multnomah	WV	Point [Areal - Estimated (8050 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
002N001E	32		45122-E6	Portland	1709001004 - ROCK CREEK
					1709001202 - SCAPPOOSE CREEK/MULTNOMAH CHANNEL

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		

EO Type: Minimum Elev.(m): 3
EO Data: 1985: 1 CUCKOO HEARD. 1940: 2 BIRDS ON 7-27. 1923: AT LEAST 12 BIRDS ON 6-8.

Annual Observations

EO Comments: COLUMBIA RIVER BOTTOMLANDS
Protection:
Management:
General: OBSERVERS: MIKE HOUCK (1985), W.H. TELFER (1940), GABRIELSON AND JEWETT (1923).

Scientific Name: ***Agelaius tricolor***
Common Name: **Tricolored blackbird**
Federal Status: SOC GRANK: G2G3 NHP List: 2 Category: Vertebrate Animal
State Status: SP SRANK: S2B HP Track: Y ELCODE: ABPBXB0020
EO ID: 17658 First Obs: 1983 Last Obs: 1985 Confirmed:
Directions: ST. JOHNS LANDFILL IN PORTLAND

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Multnomah	WV	Point [Areal - Estimated (1500 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
001N001E	05		45122-E6	Portland	1709001202 - SCAPPOOSE CREEK/MULTNOMAH CHANNEL

Owner Name/Type	Owner Comments	Managed Area Name
CITY	CITY OF PORTLAND	

EO Type: Minimum Elev.(m): 6

Annual Observations

EO Data: 1985: A COLONY OF 20-30 BIRDS PRESENT DURING THE NESTING SEASON. 1983: 36 BIRDS OBSERVED 6/25-7/31, APPARENTLY NESTING.

EO Comments: DENSE HIMALAYAN BLACKBERRIES ADJACENT TO A BLIND SLOUGH W/ SPARSE TREE COVER ALONG THE SLOUGH MARGINS

Protection:

Management:

General: REPORTED BY HOUCK ET AL. THIS COLONY WOULD BE ABOUT 250 MI N OF THE CLOSEST NESTING AREAS IN THE ROGUE RIVER VALLEY

Scientific Name: ***Acipenser medirostris***

Common Name: **Green sturgeon**

Federal Status: SOC GRANK: G3 NHP List: 4 Category: Vertebrate Animal

State Status: SRANK: S3 HP Track: N ELCODE: AFCAA01030

EO ID: 19198 First Obs: Last Obs: Confirmed:

Directions: COLUMBIA RIVER AND ESTUARY, UPSTREAM TO BONNEVILLE DAM. WILLAMETTE RIVER BELOW WILLAMETTE FALLS.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Clatsop	CR	Line [Linear (8 m)]
Columbia	WC	Line [Linear (8 m)]
Multnomah	WV	

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
008N010W			45121-E8	Tanner Butte	1708000105 - COLUMBIA GORGE TRIBUTARIES W.
008N009W			45121-F8	Bonneville Dam	1708000106 - GORDON CREEK/LOWER SANDY RIVER
008N008W			45122-C5	Oregon City	1708000302 - BEAVER CREEK
009N008W			45122-D5	Gladstone	1708000303 - PLYMPTON CREEK
009N007W			45122-D6	Lake Oswego	1708000601 - YOUNGS BAY TRIBUTARIES
008N006W			45122-E1	Multnomah Falls	1708000602 - BIG CREEK / GNAT CREEK
009N006W			45122-E2	Bridal Veil	1709000704 - ABERNATHEY CREEK
			45122-E3	Washougal	1709001201 - JOHNSON CREEK
			45122-E4	Camas	1709001202 - SCAPPOOSE CREEK/MULTNOMAH CHANNEL
			45122-E5	Mount Tabor	
			45122-E6	Portland	
			45122-E7	Linnton	
			45122-F6	Vancouver	
			45122-F7	Sauvie Island	
			45122-G7	Saint Helens	
			45122-H7	Deer Island	
			46122-A7	Kalama	
			46122-A8	Rainier	
			46122-B8	Kelso	
			46123-B1	Coal Creek	
			46123-B2	Oak Point	
			46123-B3	Nassa Point	
			46123-B4	Cathlamet	
			46123-B6	Cathlamet Bay	
			46123-B7	Astoria	
			46123-B8	Warrenton	
			46123-C4	Skamokawa	
			46123-C5	Grays River	
			46123-C6	Rosburg	
			46124-B1	Clatsop Spit	

Owner Name/Type	Owner Comments	Managed Area Name
STATE		

EO Type: YEAR-ROUND - fish Minimum Elev.(m): Annual Observations

EO Data: NO COLLECTION INFORMATION AVAILABLE. GREEN STURGEON ADULTS ARE ABUNDANT AND THE NUMBERS ARE STABLE IN THE LOWER COLUMBIA RIVER. THEY ARE RARELY FOUND IN THE COLUMBIA RIVER FROM PUGET ISLAND (RM40) UPSTREAM TO BONNEVILLE DAM AND TO WILLAMETTE FALLS IN THE WILLAMETTE RIVER. (1995 ODFW BIENNIAL REPORT ON THE STATUS OF WILD FISH IN OREGON)

EO Comments:

Protection:

Management:

General: GREEN STURGEON NOT ABUNDANT IN ANY PACIFIC COAST ESTUARY. LITTLE IS KNOWN ABOUT ITS LIFE HISTORY. THIS SPECIES MORE MARINE ORIENTED THAN WHITE STURGEON AND SPENDS LIMITED AMOUNT OF TIME IN FRESHWATER (EXCEPT PERHAPS EARLY JUVENILES AND SPAWNING AOULTS). B91NOA01ORUS.

Scientific Name: ***Oncorhynchus kisutch pop. 1***

Common Name: **Coho salmon (Lower Columbia River/SW Washington Coast ESU)**

Federal Status: PT GRANK: G4T2Q NHP List: 1 Category: Vertebrate Animal

State Status: LE SRANK: S2 HP Track: Y ELCODE: AFCHA02031

EO ID: 3164 First Obs: Last Obs: 1999-PRE Confirmed:

Directions: SCAPPOOSE BAY, MULTNOMAH CHANNEL, WILLAMETTE RIVER

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Clackamas		Data currently not available.
Columbia		
Multnomah		

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
			45122-C5	Oregon City	17090012 - Lower Willamette
			45122-D5	Gladstone	
			45122-D6	Lake Oswego	
			45122-E6	Portland	
			45122-E7	Linnton	
			45122-F7	Sauvie Island	
			45122-G7	Saint Helens	

Owner Name/Type	Owner Comments	Managed Area Name

EO Type: REARING & MIGRATION - fish Minimum Elev.(m): Annual Observations

EO Data: ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE

EO Comments:

Protection:

Management:

General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 1999. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF COHO IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus tshawytscha pop. 21***

Common Name: **Chinook salmon (Lower Columbia River ESU, spring run)**

Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal

State Status: SC SRANK: S2 HP Track: Y ELCODE: AFCHA0205W

EO ID: 3132 First Obs: Last Obs: 1999-PRE Confirmed:

Directions: SCAPPOOSE BAY, MULTNOMAH CHANNEL, WILLAMETTE RIVER

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Clackamas		Data currently not available.
Columbia		
Multnomah		

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
			45122-C5	Oregon City	17090012 - Lower Willamette
			45122-D5	Gladstone	
			45122-D6	Lake Oswego	
			45122-E6	Portland	
			45122-E7	Linnton	
			45122-F7	Sauvie Island	
			45122-G7	Saint Helens	

Owner Name/Type | Owner Comments | Managed Area Name

EO Type: REARING & MIGRATION - fish Minimum Elev.(m): Annual Observations
EO Data: SPRING RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE
EO Comments:
Protection:
Management:
General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 1999. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF CHINOOK IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus tshawytscha pop. 22***
Common Name: **Chinook salmon (Lower Columbia River ESU, fall run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: AFCHA0205Y
EO ID: 778 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: SCAPPOOSE BAY & TRIBUTARIES, WILLAMETTE RIVER & TRIBUTARIES

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Clackamas		Data currently not available.
Columbia		
Multnomah		

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
			45122-C5	Oregon City	17090012 - Lower Willamette
			45122-D5	Gladstone	
			45122-D6	Lake Oswego	
			45122-E6	Portland	
			45122-E7	Linnton	
			45122-F7	Sauvie Island	

Owner Name/Type | Owner Comments | Managed Area Name

EO Type: REARING & MIGRATION - fish Minimum Elev.(m): Annual Observations
EO Data: FALL RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE
EO Comments:
Protection:
Management:
General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 1999. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF CHINOOK IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Oncorhynchus mykiss pop. 27***
Common Name: **Steelhead (Lower Columbia River ESU, winter run)**
Federal Status: LT GRANK: G5T2Q NHP List: 1 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: AFCHA02132
EO ID: 851 First Obs: Last Obs: 1999-PRE Confirmed:
Directions: SCAPPOOSE BAY, MULTNOMAH CHANNEL, WILLAMETTE RIVER

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Clackamas		Data currently not available.
Columbia		
Multnomah		

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
			45122-C5	Oregon City	17090012 - Lower Willamette
			45122-D5	Gladstone	
			45122-D6	Lake Oswego	
			45122-E6	Portland	
			45122-E7	Linnton	
			45122-F7	Sauvie Island	
			45122-G7	Saint Helens	

Owner Name/Type | Owner Comments | Managed Area Name

EO Type: REARING & MIGRATION - fish | Minimum Elev.(m): | Annual Observations

EO Data: WINTER RUN: ODFW DISTRIBUTIION MAPS USED TO CREATE THE 1:24,000 COVERAGE

EO Comments:

Protection:

Management:

General: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 1999. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF STEELHEAD IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.

Scientific Name: ***Corynorhinus townsendii***

Common Name: **Townsend's big-eared bat**

Federal Status: SOC	GRANK: G4	NHP List: 2	Category: Vertebrate Animal
State Status: SC	SRANK: S2	HP Track: Y	ELCODE: AMACC08010
EO ID: 6409	First Obs: 1914	Last Obs: 1928-09-05	Confirmed:

Directions: Sensitive Data - contact ORNHIC for more information

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Multnomah	WV	Point [Areal - Estimated (8050 m)]

Town-Range	Sec	Note	Watershed
001N001E			1709001005 - LOWER TUALATIN RIVER
			1709001201 - JOHNSON CREEK
			1709001202 - SCAPPOOSE CREEK/MULTNOMAH CHANNEL

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		

EO Type: | Minimum Elev.(m): 46 | Annual Observations

EO Data: Sensitive Data - contact ORNHIC for more information

EO Comments:

Protection:

Management:

General:

Scientific Name: ***Chrysemys picta***

Common Name: **Painted turtle**

Federal Status:	GRANK: G5	NHP List: 2	Category: Vertebrate Animal
State Status: SC	SRANK: S2	HP Track: Y	ELCODE: ARAAD01010
EO ID: 5760	First Obs: 1985-06	Last Obs: 1993-06	Confirmed:

Directions: SMYTH-BYBEE LAKES

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Multnomah	WV	Point [Areal - Estimated (4000 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
002N001E	31		45122-E6	Portland	1709001202 - SCAPPOOSE CREEK/MULTNOMAH CHANNEL

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		

EO Type: | Minimum Elev.(m): 3 | Annual Observations

EO Data: 1993: 128 INDIVIDUALS OBSERVED. 1985: 1 PAINTED TURTLE OBSERVED.

EO Comments: SUNNING LOGS & SNAILS ABUNDANT. NO OTHER TURTLE SPECIES PRESENT. BULLFROGS ABUNDANT

Protection:

Management:

General: OBSERVERS: MARK HAYES AND DAN HOLLAND (1993). PHILLIP GADDIS AND CHAR CORKRAN (1985).

Scientific Name: ***Chrysemys picta***
Common Name: **Painted turtle**
Federal Status: GRANK: G5 NHP List: 2 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: ARAAD01010
EO ID: 20014 First Obs: 1965-04-10 Last Obs: 1965-04-10 Confirmed:
Directions: HOYT PARK, FAIRVIEW BOULEVARD.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Multnomah	CR	Point [Areal - Estimated (800 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
001S001E	05		45122-E6	Portland	1709001202 - SCAPPOOSE CREEK/MULTNOMAH CHANNEL

Owner Name/Type	Owner Comments	Managed Area Name
CITY	HOYT ARBORETUM	

EO Type: Minimum Elev.(m): 235 Annual Observations
EO Data: 1965: 1 INDIVIDUAL COLLECTED
EO Comments:
Protection:
Management:
General: OBSERVER: CAVANAGH, R. PORTLAND STATE UNIVERSITY SPECIMEN #002431.

Scientific Name: ***Chrysemys picta***
Common Name: **Painted turtle**
Federal Status: GRANK: G5 NHP List: 2 Category: Vertebrate Animal
State Status: SC SRANK: S2 HP Track: Y ELCODE: ARAAD01010
EO ID: 23920 First Obs: 1991-08-02 Last Obs: 1991-08-09 Confirmed:
Directions: PORTLAND AUDUBON SOCIETY POND, 5151 NW CORNELL RD.

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Multnomah	CR	Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
001N001E	31		45122-E6	Portland	1709001202 - SCAPPOOSE CREEK/MULTNOMAH CHANNEL

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE	PORTLAND AUDUBON SOCIETY	

EO Type: Minimum Elev.(m): 137 Annual Observations
EO Data: 1991: 1 INDIVIDUAL OBSERVED.
EO Comments:
Protection:
Management:
General:

Scientific Name: ***Fisherola nuttalli***
Common Name: **Shortface lanx (=Giant Columbia River limpet)**
Federal Status: GRANK: G2 NHP List: 1 Category: Invertebrate Animal
State Status: SRANK: S1S2 HP Track: Y ELCODE: IMGASL6010
EO ID: 20861 First Obs: 1982 Last Obs: 1985 Confirmed:
Directions: COLUMBIA RIVER, NEAR PORTLAND

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Multnomah	WV	Point [Areal - Estimated (8050 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
002N001E	35		45122-E6	Portland	1709001202 - SCAPPOOSE CREEK/MULTNOMAH CHANNEL

Owner Name/Type	Owner Comments	Managed Area Name
STATE		

EO Type: Minimum Elev.(m): 5 Annual Observations
EO Data: SAMPLED BY FREST '88 - POPULATION MAY BE EXTINCT.
TAYLOR OBSERVED IN '82 AND '85.
EO Comments: STREAM SIZE EVIDENTLY NOT A FACTOR IF IT IS RELATIVELY UNPOLLUTED, COLD AND WELL OXYGENATED, WITH PERMANENT FLOW AND A COBBLE-BOULDER SUBSTRATE; THESE CONDITIONS OCCUR IN RAPIDS.
Protection:
Management:

General: SURVEY OF COLUMBIA RIVER BASIN STREAMS FOR GIANT COLUMBIA RIVER SPIRE SNAIL AND GREAT COLUMBIA RIVER LIMPET, PACIFIC NW LABORATORY 10-89.

Scientific Name: ***Rotala ramosior***
Common Name: **Toothcup**
Federal Status: GRANK: G5 NHP List: 2 Category: Vascular Plant
State Status: SRANK: S2 HP Track: Y ELCODE: PDLYT0B030
EO ID: 27208 First Obs: Last Obs: Confirmed:
Directions:

County Name: Multnomah
Ecoregion: WV
Source Feature [Uncertainty Type (Distance)]: Point [Areal - Estimated (4000 m)]

Town-Range	Sec	Note
002N001E	33	
002N001E	31	
002N001E	29	
002N001E	19	
001N001E	15	
001N001E	17	
001N001E	09	
001N001E	07	
001N001E	03	
001N001E	06	
002N001E	34	
001N001E	05	
001N001E	04	
001N001E	02	
001N001E	08	
001N001E	10	
001N001E	11	
001N001E	16	
002N001E	30	
002N001E	28	
002N001E	32	

QuadCode	QuadName
45122-E6	Portland
45122-F6	Vancouver

Watershed: 1709001202 - SCAPPOOSE CREEK/MULTNOMAH CHANNEL

Owner Name/Type
Owner Comments
Managed Area Name

EO Type:
Minimum Elev.(m):
Annual Observations
EO Data:
EO Comments:
Protection:
Management:
General:

Scientific Name: ***Cimicifuga elata***
Common Name: **Tall bugbane**
Federal Status: GRANK: G3 NHP List: 1 Category: Vascular Plant
State Status: C SRANK: S3 HP Track: Y ELCODE: PDRAN07030
EO ID: 19613 First Obs: 1993-07-08 Last Obs: 1993-07-08 Confirmed:
Directions: FOREST PARK, LOWER MACLEAY TRAIL

County Name: Multnomah
Ecoregion: WV
Source Feature [Uncertainty Type (Distance)]: Point [Areal - Estimated (50 m)]

Town-Range	Sec	Note
001N001E	33	

QuadCode	QuadName
45122-E6	Portland

Watershed: 1709001202 - SCAPPOOSE CREEK/MULTNOMAH CHANNEL

Owner Name/Type: CITY
Owner Comments: CITY OF PORTLAND, PARKS & RECREATION
Managed Area Name:

EO Type:
Minimum Elev.(m): 61
Annual Observations:
- 1993 - 1 PLANT

EO Data: 1 PLANT, BEGINNING TO BLOOM
EO Comments: TRAILSIDE
Protection:
Management:
General: 1993 PERSONAL COMMUNICATION THROUGH LOIS KEMP

Scientific Name: ***Carex comosa***
Common Name: **Bristly sedge**

Federal Status:		GRANK:	G5	NHP List:	2-ex	Category:	Vascular Plant
State Status:		SRANK:	SH	HP Track:	Y	ELCODE:	PMCYP032Y0
EO ID:	24321	First Obs:	1887-03-06	Last Obs:	1887-03-06	Confirmed:	

Directions: "[SWAN] ISLAND" [BRACKETED INFORMATION CAME FROM THE CAREX WORKING GROUP-ONHP/SV, 5/97]

County Name	Ecoregion	Source Feature [Uncertainty Type (Distance)]
Multnomah	WV	Point [Areal - Estimated (1500 m)]

Town-Range	Sec	Note	QuadCode	QuadName	Watershed
001N001E	20		45122-E6	Portland	1709001202 - SCAPPOOSE CREEK/MULTNOMAH CHANNEL

Owner Name/Type	Owner Comments	Managed Area Name
PRIVATE		

EO Type: Minimum Elev.(m): 6

Annual Observations

EO Data: HERBARIUM COLLECTION: L.F. HENDERSON, S.N., 3-6-1887, ORE-16644.

EO Comments:

Protection:

Management:

General: HERBARIUM COLLECTION: L.F. HENDERSON, S.N., 3-6-1887, ORE-16644.

16 records total

Key to Oregon Natural Heritage Information Center Data

Field Name	Description
Scientific Name	The scientific name of the species.
Common Name	The common name of the species.
Category	Value that indicates the broad biological category for each species.
ELCODE	Unique Heritage Program code for identifying this element. 1st and 2nd byte (PD=Plant dict, PM=Plant monocot, PG=Plant gymnosperm, PP=Plant pteridophyte, AA=amphibian, AB=bird, AF=fish, AM=mammal, AR=reptile, I=invertebrate. 3rd-5th byte (family abbreviation). 6th-7th (genus code). 8th-9th (species). 10th (tie breaker).
Federal Status	US Fish and Wildlife Service or NOAA Fisheries status. **LE**=listed endangered, **LT**=listed threatened, **PE** or **PT**=proposed endangered or threatened, **C**=candidate for listing with enough information available for listing, **SOC** or **SC**=species of concern, **PS:**xx=partial status for species.
State Status	For animals, Oregon Department of Fish and Wildlife status; **LE**=listed endangered, **PE**=proposed endangered, **PT**=proposed threatened, **SC** or **C**=sensitive-critical, **SV** or **V**=sensitive-vulnerable, **SP** or **P**=sensitive-peripheral, **SU** or U=sensitive-undetermined status. For plants, Oregon Department of Agriculture status; **LE**=listed endangered, **LT**=listed threatened, **C**=candidate.
GRANK/SRANK	ORNHIC participates in an international system for ranking rare, threatened and endangered species throughout the world. The system was developed by The Nature Conservancy and is now maintained by NatureServe in cooperation with Heritage Programs or Conservation Data Centers (CDCs) in all 50 states, in 4 Canadian provinces, and in 13 Latin American countries. The ranking is a 1-5 scale, primarily based on the number of known occurrences, but also including threats, sensitivity, area occupied, and other biological factors. In this book, the ranks occupy two lines. The top line is the Global Rank and begins with a "G". If the taxon has a trinomial (a subspecies, variety or recognized race), this is followed by a "T" rank indicator. A "Q" at the end of this line indicates the taxon has taxonomic questions. The second line is the State Rank and begins with the letter "S". The ranks are summarized as follows: **1** = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences; **2** = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (extirpation), typically with 6-20 occurrences; **3** = Rare, uncommon or threatened, but not immediately imperiled, typically with 21-100 occurrences; **4** = Not rare and apparently secure, but with cause for long-term concern, usually with more than 100 occurrences; **5** = Demonstrably widespread, abundant, and secure; **H** = Historical Occurrence, formerly part of the native biota with the implied expectation that it may be rediscovered; **X** = Presumed extirpated or extinct; **U** = Unknown rank; **?** = Not yet ranked, or assigned rank is uncertain.
NHP list	All rare species in Oregon are assigned a list number of 1, 2, 3 or 4, where **1**=threatened or endangered throughout range, **2**=threatened or endangered in Oregon but more common elsewhere, **3**=Review List (more information is needed), **4**=Watch List (currently stable). A null value indicates the species is not currently on our rare species list.
HP Track	We currently obtain and computerize locational information for only those elements marked with **Y**(es). Those species marked with **N**(o) or **W**(atch) have incomplete data because we do not actively track them at this time.
EO ID	Unique identifier for the Element Occurrence (EO).
First_obs	First reported sighting date for this occurrence in the form YYYY-MM-DD.
Last_obs	Last reported sighting date, usually in the form YYYY-MM-DD.
Confirmed	Indication of whether taxonomic identification of the Element represented by this occurrence has been confirmed by a reliable individual. Blank=unknown, assumed to be correctly identified. Y=Yes, confident identification. ?=identification questions.
Directions	Site name and/or directions to site.
County	County name(s) in which EO is mapped.
Ecoregion	Physiographic Province in which EO is mapped: **CR**=Coast Range, **WV**=Willamette Valley, **KM**=Klamath Mountains, **WC**=West slope and crest of the Cascades, **EC**=East slope of the Cascades, **BM**=Ochoco, Blue and Wallowa Mts., **BR**=Basin and Range, **CB**=Columbia Basin, **SP**=Snake River Plains.

Key to Oregon Natural Heritage Information Center Data

Field Name	Description
Source Feature	A Source Feature is the initial translation of a discrete unit of observation data as a spatial feature. Creation of a Source Feature requires an interpretive process. The likely location and extent of an observation is determined through consideration of the amount and direction of any variability between the recorded and actual locations of the observation data. In most cases, the Source Feature is delineated to encompass locational uncertainty. A Source Feature can be a point, line, or polygon. The type of Source Feature developed depends on both the preceding conceptual feature type and the locational uncertainty associated with the feature.
Uncertainty Type (Distance)	The recorded location of an observation of an Element may vary from its true location due to many factors, including the level of expertise of the data collector, differences in survey techniques and equipment used, and the amount and type of information obtained. This inaccuracy is characterized as locational uncertainty, and is assessed for Source Feature(s) based on the uncertainty associated with the underlying information on the location of the observation. Four categories of locational uncertainty have been identified, as follows: Negligible uncertainty is less than or equal to 6.25 meters in any dimension. Source Features with negligible uncertainty are based on a comprehensive field survey with high quality mapping and a high degree of certainty. Linear uncertainty is greater than 6.25 meters, and varies along an axis (e.g., a path, stream, ridgeline). The true location of an observation with linear uncertainty may be visualized as effectively sliding along a line that delineates the uncertainty. Areal delimited uncertainty is greater than 6.25 meters, and varies in more than one dimension. The true location of an observation can be visualized as floating within an area with a boundary that can be specifically delimited. Boundaries can be defined using roads, bodies of water, etc. Areal estimated uncertainty is greater than 6.25 meters, and varies in more than one dimension. A boundary cannot be specifically delimited based on the observation information, i.e., the actual extent is unknown. The true location of the observation can be visualized as floating within an area for which boundaries cannot be specifically delimited. Source Features with areal estimated uncertainty require that the user specify an estimated uncertainty distance to be used for buffering the feature to incorporate the locational uncertainty.
Town-Range, Sec, and Note	United States rectangular land survey (also known as the Public Land Survey System) legal township, range, and section descriptions that best define the location of the Element Occurrence. Township first (4 bytes), range second (4 bytes). For example: 004S029E = Township 4S, Range 29E. All locations are with reference to the Willamette Meridian. Fractional ranges or townships are indicated in the Note field.
Quadcode	USGS code for the USGS topographic quadrangle map(s) where the record is mapped.
Quadname	Name of the USGS topographic quadrangle map(s) where the record is mapped.
Watershed	Watershed(s), identified according to the U.S. Geological Survey (USGS) Hydrologic Unit Map 10-digit code, within which the Element Occurrence is located.
Owner Name/Type and Comments	Federal, State, Private, etc.
Managed Area Name	BLM District, USFS Forest, Private Preserve
EO Type	For animals, type of occurrence, eg. roost, nest, spawning, etc.
EO Data	Species and population biology - numbers, age, nesting success, vigor, phenology, disease, pollinators, etc.
EO Comments	Habitat information, e.g. aspect, slope, soils, associated species, community type, etc.
Minimum Elevation	Minimum elevation of the area covered by the range of the taxon, in meters. -339 or blank=not determined.
Annual Observation	Summary of yearly observation.
Protection	Comments on protectibility and threats.
Management	Comments on how the site is managed.
General	Miscellaneous comments.

Attachment 4

Photo Log

S:\GIS\ARCPRJ2\010116\COV\NEWFIELDS\WS_OU\OU2\PSY_OU2_DRAFT_PHOTOS.MXD
Main Parking Lot
Channel Ave. Fabrication Site
Freightliner Storage
Building 83
Berth 315
1
2
3
4
5
6
7
8
9
Legend
Approximate OU2 Boundary
0
150
300
Feet
N

1. Looking northwest at former location of Building 81.

2. Looking southwest across Facility from north boundary.

3. Looking northeast from center of Facility.

4. Looking southeast along north Facility boundary.

5. Looking northwest from catwalk.

6. Looking southeast from catwalk.

7. Looking northwest along bank.

8. Looking northwest from southeast corner of Facility.

9. Vegetation at top of bank.

Oregon
Theodore Kulongoski, Governor

Department of Environmental Quality
Northwest Region Portland Office
2020 SW 4th Avenue, Suite 400
Portland, OR 97201-4987
(503) 229-5263
FAX (503) 229-6945
TTY (503) 229-5471

March 22, 2006

Anne Summers, Environmental Program Manager
Port of Portland
PO Box 3529
Portland, OR 97208

SUBJECT: North Channel Ave. Fabrication Site – Risk Assessment

Dear Ms. Summers:

Thank you for providing the Operable Unit 2 (aka North Channel Ave. Fabrication site) Risk Assessment Work Plan Addendum and Level 1 Scoping Ecological Risk Assessment (February 14, 2006) for the Portland Shipyard site located on Swan Island in Portland, OR. We approve of the proposed approach to completing the risk assessment in this area assuming the following comments are addressed. Please send a schedule for completing this work along with the Figure requested in comment 1.

Comments

Work Plan Addendum

1. Proposed sampling locations (items 1 and 2, pages 1 and 2) and surface soil sample locations (referenced in item 2 on page 3) should be shown on a site figure.
2. No sampling is proposed to address potential impacts of stormwater runoff from the northernmost pipe that historically discharged accumulated rainwater to the river based on lack of potential sources in the area that would have been drained by this pipe. However, there has been limited sampling in this drainage area and past site use includes a variety of industrial activities. Soil should be sampled at the discharge location of this pipe, consistent with the proposal for the more southern pipe. Samples at this location and at the discharge location for the more southern pipe should be analyzed for TPH, PAHs, PCBs, TBT, and metals. (Note that the results of this sampling may be considered in evaluating the need for samples between the removal action area and the shoreline.)
3. Evaluation of potential residual sediments within the pipes should be completed. Note that source control measures at this site should include permanent closure of these pipes unless the risk assessment is expanded to include evaluation of potential impacts to the river should they be used for stormwater drainage in the future.
4. Analytical results for all metals covered by EPA Method 6010 should be reported for the supplemental soil samples collected to define the extent of

contamination outside the boundaries of the removal action, rather than a subset as proposed.

5. Note that historical data from MW-11 indicates vinyl chloride was detected at concentrations that exceed the Portland Harbor screening levels and more recent data indicates exceedances of arsenic screening levels. Additional groundwater sampling may be necessary to fully evaluate this potential pathway to the river.

Level 1 Scoping ERA

6. Please provide a copy of the riverbank development mitigation plan referenced at the bottom of page 3.

7. Section 3 indicates that site topography prevents upland soils from being transported to the river via runoff. Please provide the associated documentation; e.g., site surveys indicating slope is away from the river.

8. The following clarifications should be noted for Attachment 1 – Ecological Scoping Checklist:

   a. Part 2 is intended to document observed impacts associated with the site. The findings appear to indicate extent of vegetation as opposed to impacts to the vegetation.

   b. The percentages of land types documented in Part 3 do not appear to represent the entire site. We expect that there is a higher percentage of ruderal habitat than indicated.

   c. The summary statement regarding ecologically important habitats observed states that there are no ecologically important habitats at OU2. This is not accurate as the bank along the river is an ecologically important habitat.

Based on the results of the Level 2 evaluation described in the Risk Assessment Work Plan and Addendum, it may be determined that additional site characterization data is warranted. Recommendations addressing these data gaps should be included in the Level 2 Report. If you have any questions, feel free to call me at (503) 229-6148.

Sincerely,

Jennifer Sutter, Project Manager
Cleanup/Lower Willamette Section

Cc: Jim Anderson, PHS/NWR
Mike Poulsen, CU-LWS/NWR
Stuart Brown, Bridgewater Group, Inc.

PORT OF PORTLAND

July 25, 2006

Ms. Jennifer Sutter
Oregon Department of Environmental Quality
2020 SW Fourth Avenue, Suite 400
Portland, OR 97201-4987

Subject: **Swan Island Upland Facility/Portland Shipyard**
Operable Unit 2 Risk Assessment
ECSI No. 271

Dear Ms. Sutter:

The Port of Portland (Port) has prepared responses to your March 22, 2006 comments on our Operable Unit 2 (OU2) Risk Assessment Work Plan Addendum and Level 1 Scoping Ecological Risk Assessment for the Swan Island Upland Facility (SIUF). Each Oregon Department of Environmental Quality (DEQ) comment is presented below (in italics) followed by the Port's response.

Work Plan Addendum Comments

1. *Proposed sampling locations (items 1 and 2, pages 1 and 2) and surface soil sample locations (referenced in item 2 on page 3) should be shown on a site figure.*

   The attached Figures 1 and 2 illustrate the proposed riverbank and upland surface soil sampling locations. As was discussed in our April 20, 2006 meeting, the Port will collect three soil samples from the riverbank, below the end of both storm water drainage pipes. Figure 1 shows the approximate locations where these samples will be collected. Also, as was discussed in our meeting, the three discrete samples collected below each drain pipe will be combined in the laboratory to create a composite sample; the remaining portion of each discrete sample will be retained by the laboratory for possible future analysis.

   Figure 2 illustrates the proposed locations where upland surface soil samples will be collected 25, 50 and 75 feet to the southwest of the southwest boundary of the OU2 removal action area (i.e., locations S-51, S-52 and S-53) to define the extent of contamination between the former arsenic hot spot and the top of the river bank, and 25, 50 and 75 feet east of the east corner of the OU2 removal action area (i.e., locations S-54, S-55 and S-56) to define the extent of contamination between the former arsenic hot spot and the catch basin located at the far southeast end of OU2.

2. *No sampling is proposed to address potential impacts of stormwater runoff from the northernmost pipe that historically discharged accumulated rainwater to the river based on lack of potential source in the area that would have been drained by this pipe. However, there has been limited sampling in this drainage area and past site use*

includes a variety of industrial activities. Soil should be samples at the discharge location of this pipe, consistent with the proposal for the more southern pipe. Samples at this location and at the discharge location for the more southern pipe should be analyzed for TPH, PAHs, PCBs, TBT, and metals. (Note that the results of this sampling may be considered in evaluating the need for samples between the removal action area and the shoreline).

As was discussed in our April 20, 2006 meeting and is illustrated in Figure 1, the Port will collect three soil samples from the riverbank below the end of the northernmost pipe. The samples will be collected using the same approach as was proposed for the southernmost pipe.

Also as was discussed in our meeting, the Port will analyze both riverbank composite soil samples for TPH, PAHs, PCBs and metals. As you agreed during your April 24, 2006 telephone conversation with Stuart Brown/Bridgewater Group, the riverbank composite soil samples will not need to be analyzed for TBT.

3. *Evaluation of potential residual sediments within the pipes should be completed. Note that the source control measures at this site should include permanent closure of these pipes unless the risk assessment is expanded to include evaluation of potential impacts to the river should they be used for stormwater drainage in the future.*

   As was discussed in our April 20, 2006 meeting, the Port intends to remove both storm water drainage pipes and this work is scheduled for completion on July 28, 2006. Because the Port is sampling riverbank soils below the end of each pipe, residual sediments, if any, within the pipes will not be sampled.

4. *Analytical results for all metals covered by EPA Method 6010 should be reported for the supplemental soil samples collected to define the extent of contamination outside the boundaries of the removal action, rather than a subset as proposed.*

   EPA Method 6010 covers a broad range of metals that exceeds the list of constituents of interest (COIs) for the SIUF. Consistent with prior soil sample analyses for metals, analytical results will be reported for antimony, arsenic, cadmium, chromium, copper, lead, nickel, silver and zinc.

5. *Note that historical data from MW-11 indicates that vinyl chloride was detected at concentrations that exceed the Portland Harbor screening levels and more recent data indicates exceedances of arsenic screening levels. Additional groundwater sampling may be necessary to fully evaluate this potential pathway to the river.*

   As was discussed in our April 20, 2006 meeting, the Port proposes to resample MW-11 to determine whether vinyl chloride in still present in groundwater at that location. The last time a groundwater sample from MW-11 was analyzed for volatile organic compounds was in October 2002. There is no need to resample for arsenic because the annual groundwater sampling program for the SIUF includes the analysis of the groundwater sample collected at MW-11 for metals. At our meeting we discussed the fact that arsenic concentrations exceed screening levels in many of the SIUF monitoring wells even though arsenic concentrations in most of the facility soils are at or below background levels. Thus, it appears that the arsenic detected in groundwater at MW-11, and elsewhere at the SIUF, is naturally occurring. The Port will provide additional information to support this position in our OU1 Phase II work plan addendum.

Level I Scoping ERA

6. *Please provide a copy of the riverbank development mitigation plan referenced at the bottom of page 3.*

   The City of Portland Hearings Officer Decision Report and Bureau of Planning staff report that approves the Port's Swan Island Riverbank Development Mitigation Plan is attached.

7. *Section 3 indicates that site topography prevents upland soils from being transported to the river via runoff. Please provide the associated documentation; e.g., site surveys indicating slope is away from the river.*

   Figure 3 illustrates the topography of the unpaved portion of OU2 (i.e., between the main parking lot and the southeast property line). The topographic map is based on a Port land survey of the riverbank and an approximately 200-foot-wide strip of uplands along the riverbank. As the map indicates, the upland portion of OU2 along the riverbank is relatively flat and does not slope toward the river. Rainfall either infiltrates into the ground or accumulates in localized depressions. The storm water drainage pipes were installed to drain these depressions.

8. *The following clarifications should be noted for Attachment 1 – Ecological Scoping Checklist:*
   a. *Part 2 is intended to document observed impacts associated with the site. The findings appear to indicate extent of vegetation as opposed to impacts to the vegetation.*
   b. *The percentages of land types documented in Part 3 do not appear to represent the entire site. We expect that there is a higher percentage of ruderal habitat than indicated.*
   c. *The summary statement regarding ecologically important habitats observed states that there are no ecologically important habitats at OU2. This is not accurate as the bank along the river is an ecologically important habitat.*

   The enclosed Level I – Ecological Scoping Checklist for OU2 has been revised in response to DEQ's comments. Part 2 has been revised to indicate that no impacts associated with the site were observed. Part 3 has been revised to more accurately reflect the percentages of different land types. Finally, the "Ecologically Important Species/Habitats Observed" section of Part 3 has been revised to indicate that the riverbank is riparian habitat that DEQ considers to be important habitat.

Proposed Schedule

The Port proposes to collect the riverbank and surface soil samples and MW-11 groundwater sample within four weeks of receiving approval of our comment responses from DEQ. A technical memorandum summarizing the laboratory analytical results and proposed next steps for the human health and ecological risk assessments will be submitted four weeks after receipt of final laboratory results.

If you have any questions regarding our responses, please give me a call at 503-944-7323.

Sincerely,

Nicole Anderson

Nicole Anderson
Environmental Program Manager

Attachments:

1) Figure 1: OU2 Storm Water Pipe and Riverbank Sampling Locations
2) Figure 2: OU2 Soil Sampling Locations
3) Figure 3: OU2 Topographic Map
4) Swan Island Riverbank Development Mitigation Plan
5) Ecological Scoping Checklist and Evaluation of Receptor-Pathway Interactions

c: David Ashton, Port (w/o attachments)
Anne Summers, Port (w/o attachments)
Bob Teeter, Port (w/o attachments)
Stu Brown, Bridgewater (w/o attachments)
Amanda Spencer, Ash Creek Associates (w/o attachments)
Mark Lewis, NewFields (w/o attachments)
LWP File

CITY OF
PORTLAND, OREGON
HEARINGS OFFICE

1120 S.W. 5th Avenue, Room 1017
Portland, Oregon 97204-1960
Land Use Hearings (503) 823-7719
Code/Towing Hearings (503) 823-7307
FAX (503) 823-4347
TDD (503) 823-6868

Hearing Dates:	February 18 and July 14, 1997
Decision Mailed:	July 18, 1997
Last Date to Appeal:	August 1, 1997
Effective Date (if no appeal):	August 2, 1997

REPORT OF HEARINGS OFFICER DECISION IN UNCONTESTED CASE

File No.: 96-01086 IM AD

Applicant: Port of Portland, (Mary Gibson, Preston Beck), P.O. Box 3529, 97208.

Location: Swan Island Plan District.

Legal Description/Tax Account #s: See attached list, "Legal Description and Tax Account Numbers of Property Within Swan Island Plan District".

Quarter Sections: 2424-2426, 2525-2527. Neighborhood: Overlook.

Neighborhoods within 1,000 feet of the site: University Park, Arbor Lodge.

District Neighborhood Coalition: North Portland Neighborhood Office.

Zoning/Designations: IG2, General Industrial 2/Industrial Sanctuary.
IH, Heavy Industrial/Industrial Sanctuary.
i, River Industrial Greenway Overlay.
Swan Island Plan District.

Land Use Review: Impact Mitigation and Adjustment.

Decision: It is the decision of the Hearings Officer to adopt and incorporate into this report the facts, findings, and conclusions of the Bureau of Planning in Sections I, II, and III of their Revised Staff Report and Recommendation to the Hearings Officer received in the Hearings Office on July 3, 1997, and to issue the following approval:

Approval of the Swan Island Riverbank Development Mitigation Plan and elimination of Greenway Reviews within the Swan Island Plan District, for a period of 10 years, subject to the following conditions:

A. Amendments to this plan, if necessary during the 10-year life of this plan, will be reviewed through a Type I review for changes that affect 10 percent or less of the area (quantity) of approved improvements, or are temporary changes (as defined by Chapter 33.296, Temporary Activities), that comply with all conditions of approval; and a Type II review for other changes. Update of the plan at the end of the 10-year period, will be reviewed through the Type III procedures, and will be subject to the approval criteria of Section 33.585.050.

B. All landscaping proposed within the Portland Ship Yard, at the entrance to the ship yard, and along Lagoon Avenue (Exhibit A-1) must be implemented and in place by December 31, 1999.

C. The recommendations for landscape/habitat enhancement by Fishman Environmental Services (Exhibit A-2) for Site 10 (Boat Ramp Site) will be carried out as described by the Habitat Enhancement Plan), included in Exhibit A-7, by December 31, 1999.

D. The applicant will apply for a Type II review for approval of specific/final viewpoint/interpretive center design within six months of this approval. This application will respond to the following:

1. Three viewpoint/interpretive centers will be developed. The two identified undeveloped viewpoints, the channel module and boat launch sites, will be given priority consideration over the existing viewpoints for development/enhancement. A decision not to develop either of the two identified undeveloped viewpoints must be accompanied by a complete rationale; and

2. Viewpoint/interpretive center design will take into account all of the following considerations: weather protection, instructional/historical/topical information, seating, lighting, integration with immediate surrounding (including: design, materials, colors, landscaping), common elements and/or diversity, and signage.

Approval of the adjustment for perimeter landscaping and screening of Site 1, Channel Module Site, as identified in Exhibit A-1, pages 20-29.

Approval of the adjustment to allow for modification of the height (growing) standards of the perimeter landscaping, leaving opportunity for observation by police from Channel Avenue, and reduction of required perimeter trees from 47 to 22 for Site 2, Main PSY Parking Lot Site, subject to the following conditions:

E. Low-growing plant materials need be no higher than 30 inches in height, and may be shorter; trees may display a branching pattern or habit that does not include branches below six feet (approximately), or tightly columnar trees may be used.

F. Lighting of this parking lot will be in accordance with the identified needs of observation. A letter indicating acceptance by the Portland Police of the new level of lighting will accompany the application for the building permit for the parking lot.

G. Remove the wooden slats in the north and west perimeter fence.

Approval of an adjustment to allow interior parking lot landscaping to occupy only the existing landscape islands, within Site 2, Main PSY Parking Lot Site, with planting accommodating observation by Police from Channel Avenue (i.e., low-growing shrubs and trees with a higher branching pattern).

Approval of an adjustment to allow elimination of the required F2 fencing between Site 3, Berths 314 and 315, and the Main PSY Parking Lot.

Approval of the adjustment to eliminate the required street frontage landscaping for Site 4, Foss Environmental.

Approval of an adjustment eliminating all required interior parking lot landscaping for the parking within Site 5, Main Ship Yard, subject to the following condition:

H. All site landscaping and all new parking lot landscaping proposed by the applicant will be will be carried out as described in Exhibits A-1 and A-5, by December 31, 1999.

Approval of the adjustment to eliminate all required interior parking lot landscaping for Site 7, Risberg Truck and of the adjustment to eliminate the required F1 screening along the interior property line, subject to the following condition:

I. This site must comply with the applicable development standards at the time of redevelopment.

Approval of the adjustment to eliminate the requirement for a partially sight obscuring fence (F1 screening) for Site 8, Berth 311.

Basis for Decision: Revised Staff Report in 96-01086 IM AD, Exhibits A through H-11 (Exhibits H-6 through H-10 were returned to the applicant at the hearing), and the hearing testimony of Steve Gerber (Bureau of Planning), and Mary Gibson and Preston Beck (Applicant's Representatives).

Elizabeth A. Normand

Elizabeth A. Normand
Hearings Officer

Decisions of the Hearings Officer may be appealed to City Council. Unless appealed, this Decision of the Hearings Officer is effective on AUGUST 2, 1997, the day after the last day to appeal.

ANY APPEAL OF THIS ACTION BY THE HEARINGS OFFICER MUST BE FILED AT THE PERMIT CENTER ON THE FIRST FLOOR OF THE PORTLAND BUILDING, 1120 S.W. 5TH AVENUE, 97204 (823-7526) NO LATER THAN 4:30 P.M. ON AUGUST 1, 1997. **An appeal fee of $2,055.75 will be charged (one-half of the application fee for this case).** Information and assistance in filing an appeal can be obtained from the Bureau of Planning at the Permit Center.

Appeal of the decision. The decision of the Hearings Officer may be appealed to City Council, who will hold a public hearing. If you or anyone else appeals the decision of the Hearings Officer, only evidence previously presented to the Hearings Officer will be considered by the City Council.

Who can appeal. You may appeal the decision only if you wrote a letter which was received before the close of the record on hearing or if you testified at the hearing, or if you are the property owner or applicant.

Neighborhood associations and low-income individuals may qualify for a waiver of the appeal fee. Assistance in filing the appeal and information on fee waivers are available from the Bureau of Planning in the Permit Center in the Portland Building at 1120 S.W. 5th Avenue, first floor. Fee waivers for low-income individuals must be approved prior to filing your appeal; please allow three working days for fee waiver approval. Fee waivers for neighborhood associations require a vote of the authorized body of your association. Please see appeal form for additional information.

Recording the final decision. The applicant, builder or a representative must submit this decision to the City Auditor's Office at 1400 S.W. 5th Avenue, Room 401, Portland, Oregon. The Auditor will charge a fee, and will record this decision with the County Recorder. A building or development permit will be issued only after this decision is recorded.

Expiration of this approval. This decision expires three years from the date it is recorded unless:
- A building permit has been issued, or
- The approved activity has begun, or
- In situations involving only the creation of lots, the land division has been recorded.

Applying for your permits. A building permit, occupancy permit, or development permit must be obtained before carrying out this project. At the time they apply for a permit, permittees must demonstrate compliance with:
- All conditions imposed here.
- All applicable development standards, unless specifically exempted as part of this land use review.
- All requirements of the Building Code.
- All provisions of the Municipal Code of the City of Portland, and all other applicable ordinances, provisions and regulations of the City.

Legal Description and Tax Account Numbers of Property Within Swan Island Plan District

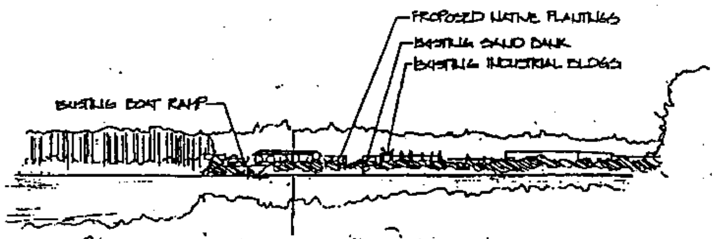
Legal Description
Section 17 1N 1E Tax Lots 17, 25, 28 36, 38, 41, 42, 43, 53, 63, 64, 65, 67, 69, 71, 77, 79, 80, 82, 84, 85, 81, 103, 105, 107, 112, 114, 116, 117, 118, 127, 128, 130, 132, 133, 590, 600
Section 20 1N 1E Tax Lots 107, 110, 114, 117
Section 21 1N 1E Tax Lots 81, 84, 88, 89, 92, 95, 99,104, 107
Partition Plat 1990-69 lot 3
Partition Plat 1990-69 Tax Lot 1 of lot 1
Partition Plat 1994-175 Parcel 200 Lot 1
Partition Plat 1994-175 parcel 300 Lot 2
Partition Plat 1994-175 Lot 1 (Formerly Lot 3)
Partition Plat 1995-139 Lot 2 (Formerly with aforementioned Lot 3)

Tax Account Numbers
R941171320, R941171320, R941171300, R941171270, R941170750, R941170790, R941170810, R941170800, R941170820, R941170770, R941170760, R941170280, R941170530, R941171180, R941170410, R941170420, R941170840, R941170630, R941170850, R941170640, R941170650, R941170690, R941170430, R941170710, R941170670, R941170380, R941201140, R941201170, R941201070, R941210840, R941201070, R941210810, R941211040, R649704140, R941170170, R941171050, R941170360, R941170250, R941171280, R941201160, R941201150, R941200930, R941201100, R941171030, R941171120, R941170600, R941170590, R941201100, R941210880, R941211070, R941210990, R941210950, R941200920, R649714970, R649746980, R649755360, R649755370

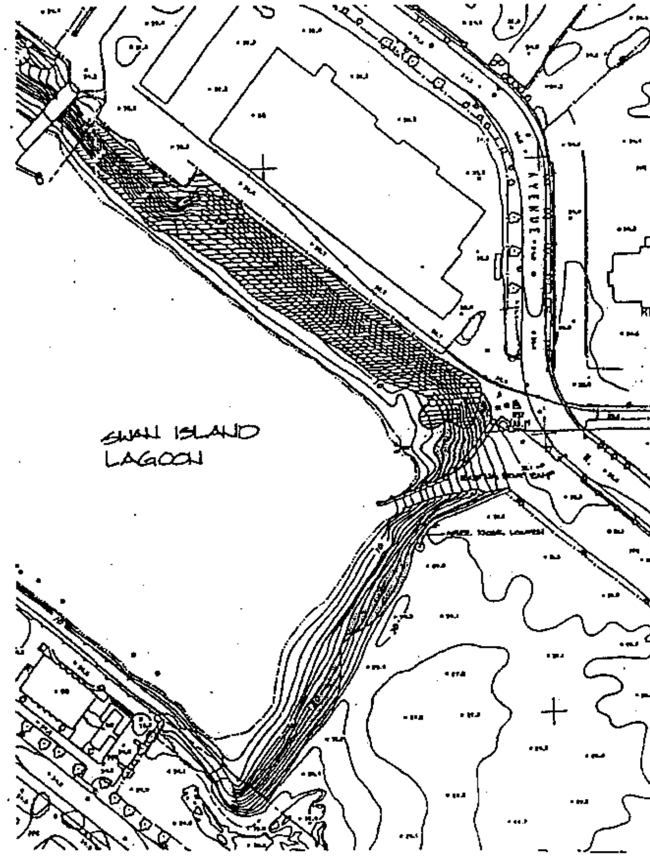
LUR96-01086

A-3

Exh. 6.7
A-7 (excerpt)



Concept Perspective



Planting Plan
1" = 100'

North

Willow Thicket Plant List

Trees		
Alnus rubra	5-6' Cont.	15
Crataegus douglasii 'douglasii'	5-6' Cont.	15
Fraxinus latifolia	5-6' Cont.	15
Shrubs		
Cornus stolonifera	24-36"	80
Oemleria cerasiformis	24-36"	20
Rosa pisocarpa	24-36"	40
Salix sitchensis	24-36"	60
Spiraea douglasii	24-36"	20
Ground Covers		
Elymus glaucus	10 lbs./Acre, Hydro-seed	
Festuca rubra 'Rubra'	8 lbs./Acre, Hydro-seed	
Lupinus bicolor	2 lbs./Acre, Hydro-seed	
'Regreen' (Cover Crop)	3 lbs./Acre, Hydro-seed	

Key

Willow Thicket 0.7 Acres
Existing Vegetation (Remove non-native vegetation) 2 Acres

Planting Notes:

1. Plantings will be watered for a 5 year period using an automatic irrigation system.
2. Plants shall be planted informally in natural groupings which best conform to the existing topography and existing site features.
3. Remove non-native vegetation, replant Willow Thicket zone with plants specified.

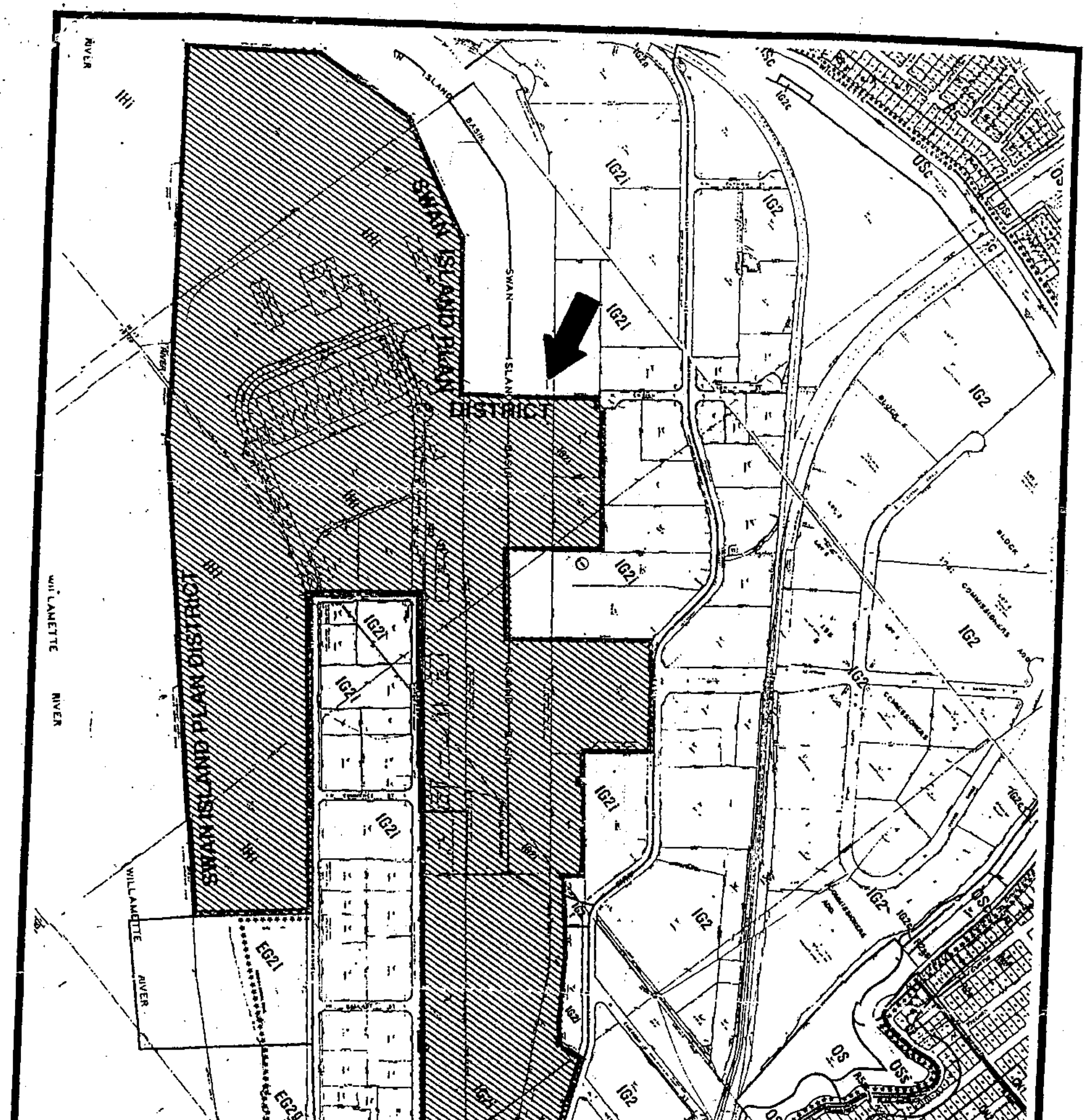
NO.	DATE	BY	REVISIONS	CK'D	APP'V'D	NO.	DATE	BY	REVISIONS	CK'D	APP'V'D

PORT OF PORTLAND
PORTLAND, OREGON

DESIGNED BY TVW
DRAWN BY TVW
CHECKED BY
DATE
SCALE

Swan Island Industrial Park
Swan Island Riverbank Mitigation
Lagoon Site Planting Plan

SUBMITTED BY
DRAWING NO.



Zoning

Site

This site lies within the SWAN ISLAND PLAN DISTRICT

NORTH

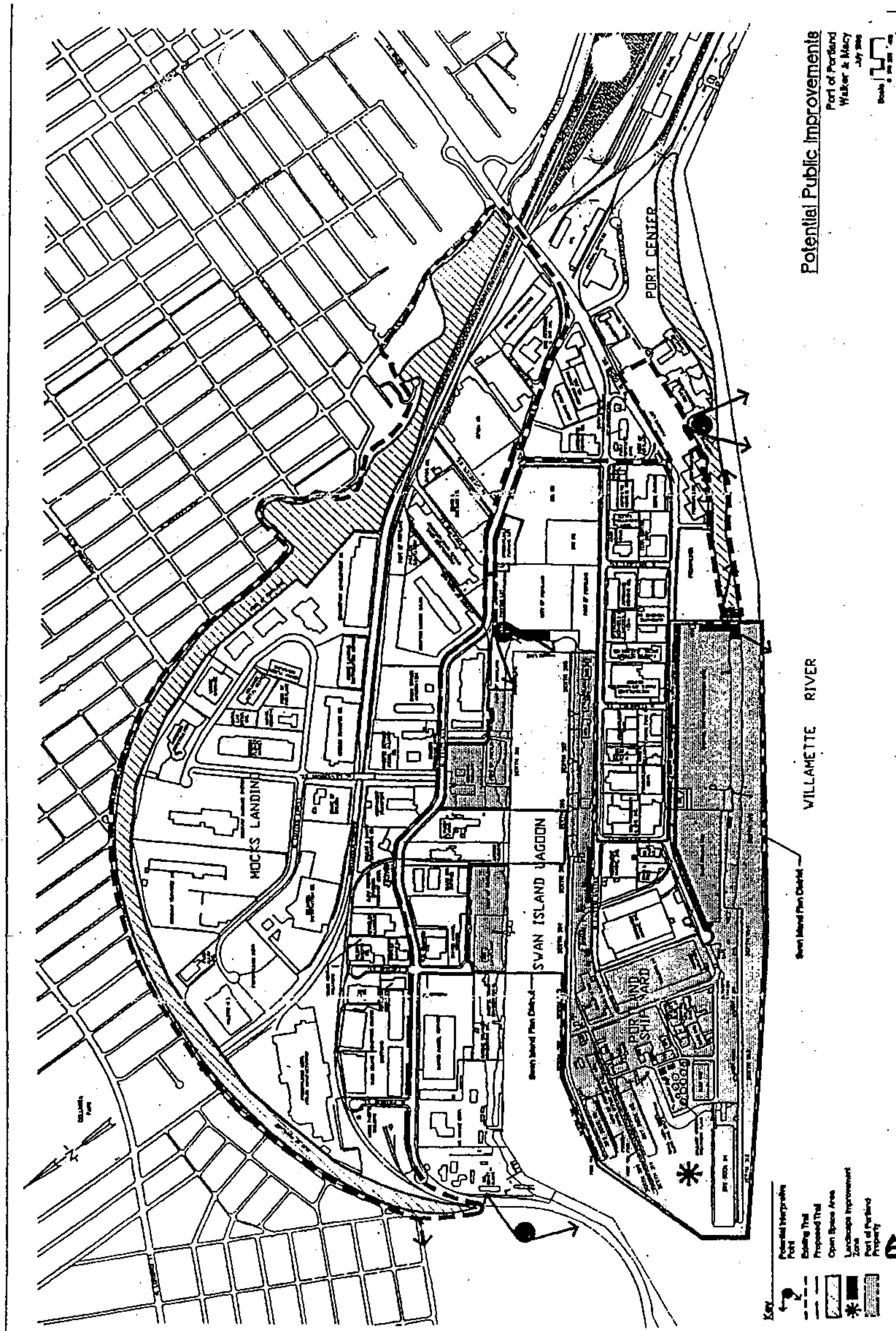
File No. LUR 96-01086 IM, AD

1/4 Section 2525-2527 2424-2426

Scale 1" = 800'

Request

Exhibit B


Potential Public Improvements
Port of Portland
Walker & Macy
PORT CENTER
WILLAMETTE RIVER
SWAN ISLAND LAGOON
MOCKS LANDING
PORTLAND SHIPYARD
Swan Island Plan District
Key
Potential Interpretive Point
Existing Trail
Proposed Trail
Open Space Area
Landscape Improvement Zone
Port of Portland Property

Ex. C.

CITY OF

PORTLAND, OREGON

BUREAU OF PLANNING

Charlie Hales, Commissioner
David C. Knowles, Director
1120 S.W. 5th, Room 1002
Portland, Oregon 97204-1966
Telephone: (503) 823-7700
FAX (503) 823-7800

REVISED STAFF REPORT and RECOMMENDATION TO THE HEARINGS OFFICER

FILE NUMBER: LUR 96-01086 IM, AD (PORT OF PORTLAND)

HEARING TO BE HELD JULY 14, 1997 AT 2:00 PM
IN HEARINGS ROOM A, 2ND FLOOR, 1120 SW 5TH AVENUE
BUREAU OF PLANNING REPRESENTATIVE: STEVE GERBER

I. GENERAL INFORMATION

Applicant/ Representative: Port of Portland (owner)
PO Box 3529
Portland, OR 97208
Attn: Mary Hopkins
Preston Beck

Location: Swan Island Plan District

Legal Description/ Tax Account #(s): See attached list, "Legal Description and Tax Account Numbers of Property Within Swan Island Plan District"

Quarter Sections: 2424-2426, 2525-2527

Neighborhood: Overlook, contact Marlene Bowen at 281-7062.

Neighborhoods within 1,000 feet of the site: University Park, contact Mark Kirchmeier at 826-3776. Arbor Lodge, contact Kent Hoddick at 326-2131.

District Neighborhood Coalition: North Portland Neighborhood Office, contact Tom Griffin-Valade at 823-4524.

Zoning/Designations: IG2, General Industrial 2/Industrial Sanctuary
IH, Heavy Industrial/Industrial Sanctuary
i, River Industrial Greenway Overlay
Swan Island Plan District

Land-Use Review: Impact Mitigation and Adjustment

Proposal: The Port of Portland proposes the Swan Island Riverbank Development Mitigation Plan as a comprehensive method to satisfy non-conforming landscape standards within the existing Swan Island Plan District and as an alternative to future Greenway Review within the Plan District. The applicant states that the Plan "is an overall strategy for proposed improvements which, if approved, the Port of Portland will implement over the next two years." The purpose of the Plan is to address the conditions of past land use decisions, to resolve non conforming landscape issues, to provide an alternative to the case-by-case Greenway review process, and to implement portions of the Swan Island Plan District as provided for in Chapter 33.585.

The components of the Plan include landscape improvements and public amenities, specifically: trails and pedestrian facilities; viewpoints and interpretive facilities; and landscape improvements. Pedestrian connectivity will be enhanced by the addition of sidewalks on the east side of N Basin Avenue from N Ensign Street, north to the end of the cul-de-sac, and on the west side of N Basin Avenue from N Anchor Street to N Emerson Street. Sidewalks will be constructed to City of Portland Standards.

There are four viewpoints and/or interpretive facilities proposed for consideration. On the Willamette river bank south of the channel module site, with elevated platform and landscaping. On Waud's Bluff, overlooking Swan Island, on or near the University of Portland campus, with historic information provided about the development and uses on Swan Island. A third on the Willamette river bank, upstream from the first, adjacent to the Freightliner facilities. Lastly, a fourth could be located at the boat launch facility to the Swan Island lagoon, providing a viewpoint into the working harbor.

Proposed landscape improvements would be located at "key" locations to provide more direct impact from landscaping that would the required Greenway landscaping, which is often forestalled by river-dependent uses and development or located in out-of-the-way places. Proposed feature landscaping would occur at the entrance to the main shipyard (Channel Avenue), internal shipyard improvements, at the foot of the Swan Island Lagoon, and along Lagoon Avenue. Habitat enhancement will also occur in the vicinity of the foot of the Swan Island Lagoon, near the boat launch facilities.

Mitigation or adjustment for non conforming base zone landscaping standards for individual sites throughout the Plan District are proposed on a site by site basis. In some instances relief from the requirement is proposed; in some instances alternative landscaping or screening is proposed; and other sites will be provided with landscaping in compliance with the present code.

The review of the proposed improvements as regards alternative compliance with the Greenway regulations, Section 33.440.210, Greenway Setback, will be approved if they are in compliance with Section 33.585.050.B.2, of the Swan Island Plan District. Review and adjustment of the proposed alternative to compliance with the base zone landscaping standards will be approved if they are in compliance with Section 33.805.040, Adjustment Approval Criteria. All non residential development must be in compliance with Chapter 33.262, Off-Site Impacts. This review will also address the State Transportation Rule, OAR 660-12-045, and its applicability to this proposal.

Description of Site and Vicinity: Swan Island is a low lying peninsula or "spit" of land projecting into the Willamette River. Through filling that occurred in early 1920's, the island is no longer separate from the shore, but is permanently attached at its south end. The island parallels the shoreline creating a lagoon between them. With the exception of a large shelf of low-lying shoreline that is east of and roughly at the same elevation as the island, the shoreline rises rapidly away from the water and island. The adjacent mainland, Overlook Neighborhood and the University of Portland, look down 150 feet onto Swan Island.

Swan Island is largely developed, the ship repair and truck manufacturing (Freightliner) facilities are the largest uses; however, numerous marine and industrial support services are also found here. The island is accessed by N Going Street, as well as several rail road lines, at its southern end.

Land Use History: There is an extensive history of land use actions within the area identified by the Swan Island Plan District, reflecting the numerous changes necessary to keep the facilities within the plan district viable. Within the plan district, the following land use cases, within the ship repair yard, have been applied for and reviewed:

- LUR 96-00172 GW, amending LUR 94-00007 GW to allow relocation of a pump house;
- LUR 95-00206 GW, approving a waste-water treatment facility, requiring the Port to initiate action on the Swan Island Riverbank Development Mitigation Plan, or apply for adjustments;
- LUR 95-00007 GW, approving new ship repair/cleaning facilities;
- LUR 92-00087 GW, approving new paint booth;
- GP 21-88, approving new storage shed (GP is an early designation for Greenway review);
- GP 2-85, approved;
- GP 7-85, approved;
- CU 19-77, approved fill; and
- CU 32-77, approved fill.

Outside the ship repair yard, but within the plan district boundaries the land use history reveals the following cases:

- LUR 96-00541 AD, relief from required landscaping denied;
- LUR 95-00472 GW, approving moorage for dredge Oregon;
- LUR 95-00289 MP, approved minor partition;
- LUR 95-00125 CU, approving moorage and operations for cruise ship berth; and
- LUR 94-00197 MP, approved minor partition.

II. ANALYSIS

The IH, Heavy Industrial, zone is one of three zones that implement the industrial sanctuary designation of the Comprehensive Plan. This zone provides area where all kinds of industries may located including those not desirable in other zones due to their objectionable impacts or appearance. The IG, General Industrial, zones (IG1 and IG2) are the other two of the three zones that implement the industrial sanctuary designation of the Comprehensive Plan. The IG2 zone is applied to areas that generally have larger lots and an irregular or large block pattern, medium to low density of building coverage, and the buildings are usually set back from the street. The IG zones provide areas where most industrial uses may locate, while other uses are restricted to prevent conflicts and to preserve the land for industrial purposes. The Swan Island facilities, including a ship repair yard and supporting industries, are appropriately located in these industrial sanctuary zones, as they have been for several years.

The i, River Industrial Greenway Overlay Zone, encourages and promotes the development of river-dependent and river-related industries which strengthen the economic viability of Portland as a marine shipping and industrial harbor, while preserving and enhancing the riparian habitat. Because of necessary river transport facilities, the uses here qualifies as river-dependent.

The Swan Island Plan District is intended to foster the continuation and growth of the Portland Ship Repair Yard. This plan district recognizes the inherent and short term changes in the types of activities occurring here, requiring flexibility in the use and configuration of the various facilities. The need for flexibility in turn affects the permanence of development amenities, such as the landscaping required by the Greenway zone. This situation is recognized in this plan through the allowance for the creation of a riverbank mitigation plan. The riverbank mitigation plan, in turn, allows for the creation of an alternative to the Greenway regulations that now apply to this area, but do not recognize the inherent need for flexibility.

A. ZONING CODE APPROVAL CRITERIA

33.585: SWAN ISLAND PLAN DISTRICT

33.585.050 Landscaping Within the Greenway Setback

A. Purpose. The Portland Ship Repair facilities are designed to allow their flexible modification and reconfiguration. This flexibility is essential both for the shipyard's ability to accommodate multiple concurrent projects and its ability to accommodate the wide variety of ship types and sizes that are attracted to its facilities. The City's greenway zone regulations assume that developed property along the Willamette will be relatively stable in its configuration and require that activities that are not water-related or water dependent be separated from the top of the river's bank by a landscaped greenway setback. The regulations of this section are intended to accommodate the ongoing changes in facility configuration inherent in the shipyard's operations while also addressing the appearance and character of the Willamette's riverbank.

B. Alternative greenway setback landscaping requirements. As an alternative to compliance with Section 33.440.210 Greenway Setback, a riverbank development mitigation plan may be developed and implemented. Such a mitigation plan must conform with the following requirements:

1. Procedure. The riverbank mitigation plan will be reviewed through a Type III procedure. Approval and compliance with the river-bank mitigation plan will constitute the required greenway review for building permit applications within the area covered by the mitigation plan.

Findings: The riverbank mitigation plan is reviewed through this Type III procedure. This procedural requirement is met.

2. Approval Criteria. The approval criteria for a riverbank mitigation plan are:

   a. The mitigation plan includes a strategy for improving the appearance of the riverbank as seen from the water. Riverbank appearance improvements may include the use of landscaped area; public art; temporary screening mechanisms; enhancement of riverbank habitat areas for fish, wildlife and native vegetation; and establishment of locations for public access to the riverbank and river surface.

Findings: The applicant offers the use of landscaping, public access and planned/improved public viewpoints to enhance the view of the riverbank from the river.

The applicant specifically notes the difficulty of maintaining enhanced habitat for wildlife and the native vegetation necessary to provide such habitat. The activities of this intense industrial area are often not conducive to native wildlife or their habitat. Periodic disruptions and intrusions, noise, and even airborne pollutants (dust and possibly others) offset any enhancements that could be provided except for the hardiest of wildlife, which are now present and will continue to be present regardless of such activities (i.e. rats, seagulls, crows and other opportunistic wildlife).

Despite the problems inherent in trying to provide and maintain landscaping in this intense environment, the applicant has identified four areas of permanent landscape improvements designed to provide the maximum impact, while creating the least conflict between landscape and work areas:

1. Entrance to Main Shipyard (Channel Avenue);
2. Shipyard Landscaping (Internal);
3. Foot of Swan Island Lagoon; and
3. Lagoon Avenue Landscaping.

The landscaping, at several locations, within the Portland Ship Yard (Exhibit A-1) will act to soften the appearance of this area, particularly from Willamette Boulevard and the designated Greenway Trail along that right-of-way. Landscaping at the entrance to the ship yard and along Lagoon Avenue will provide relief for those on Swan Island, and perhaps even to those on the river in the case of the Lagoon Avenue landscaping. Native riparian landscaping and maintenance of existing riparian habitat at the foot of the Swan Island Lagoon will not only provide for softened appearance provided by other areas of landscaping, but will also enhance the area in terms of wildlife habitat, and provide an interesting contrast to this portion of the working harbor.

Designated open space, south (upriver) of the Portland Ship Yard, and a designated landscape area at the north edge of the designated open space area, have been proposed. These existing and proposed landscaped and/or open space areas provide relief from, and contrast to the ship yard activities along the river side of the island.

The applicant proposes the development of public viewpoints identified in the <u>Request for Approval of Swan Island Riverbank Development Mitigation Plan</u> (SIRDMP), Exhibit A-1 of this report. Such viewpoints can improve the appearance of the riverbank from the river by providing relief from the industrial nature of the area and a riverbank devoted primarily to industrial activities. The ability to view the river, opposite riverbank, and industrial harbor from a facility improved and planned to provide this activity, also increases the quality of the view and the river viewing experience.

Four potential public viewpoints are identified and the applicant proposes to develop up to three of these, after additional public review. To accommodate compliance with the approval criteria, particularly the requirement that these actions improve the appearance of the riverbank, the priority location for the public viewpoints must be those locations visible from the river.

Three viewpoints are located adjacent to the river or Swan Island Lagoon, and two along the Willamette riverbank south of the Portland Ship Yard. The southernmost of these two viewpoints already exists, but is a passive viewing area with no "interpretive" information. The fourth is located on the campus of the University of Portland, on top of Waud's bluff overlooking Swan Island and the working harbor. This viewpoint also presently exists and is the focal point of a Greenway Trail designation along this edge of the University of Portland campus. This existing viewpoint is not yet officially connected to the Greenway Trail system, but will be a requirement on the University at some appropriate point in the future.

Only two new viewpoints could be created by this plan. The two existing viewpoints would be enhanced by addition of "interpretive" information, such as displays or other forms of information relating the viewpoint to the working harbor. The University of Portland's viewpoint is out of the control of the applicant and it is not clear how enhancement of this viewpoint could occur without the full cooperation and involvement of the University of Portland. The existing viewpoint along the Willamette could be enhanced as noted, but exists as a complete, useable, and integral part of the existing greenway improvements. Staff recommends that the applicant focus on the creation of the two new viewpoints discussed in this plan, and enhancement of the existing viewpoint on Swan Island.

No specific plans for the viewpoints are provided. While additional public review may well result in a better viewpoint, this lack of information leaves part of the question implied by the approval criteria unanswered. How will the specific design of these viewpoints improve the view and/or the viewing experience of and from the riverbank:

- Is weather protection important/provided?
- Should instructional, historical, or topical information be provided in some manner with each viewpoint?
- Should the viewpoints provide benches or other seating opportunities?
- Should viewpoints be available for use after dark?
- How does the viewpoint integrate with/enhance its immediate surroundings (design, materials, colors, landscaping)?
- Should viewpoints be designed with common elements, or specifically try to provide diversity?
- Should viewpoints be identified by signage; where would such signage be located, and to whom should it be oriented (pedestrians, bicyclists, drivers)?

With criteria applied to the continuing public review and a condition of approval requiring a subsequent land use review to assure that the final design choices do indeed satisfy this approval criteria, the viewpoints can significantly contribute to compliance with the approval criteria.

b. The mitigation plan recognizes that views of ships and industrial construction projects are in themselves interesting and represent an enhancement of the industrial area of the Willamette.

Findings: This plan recognizes and enhances the view of ships and industrial projects in the working harbor through the provision of planned and improved viewpoints. All viewpoints present excellent views of the working harbor. The two viewpoints located adjacent to the river offer views of the opposite shoreline, the eastern slope of the West Hills, some glimpses of activity on Swan Island, the downtown, and some of the bridges. The viewpoint proposed for the foot of the Swan Island Lagoon offers views of this portion of the working harbor, and with the planned improvements to habitat, the contrast between a more natural environment and the intense environment of the shipyard and related activities. This criterion is met.

c. The mitigation plan meets the Willamette Greenway Design Guidelines.

Findings: The Willamette Greenway Design Guidelines are discussed below:

1. Relationship of Structures to the Greenway Setback Area. Structures, other than the possibility of some sort of weather protection at the proposed viewpoints, are not part of this proposal. Landscaping, viewpoints and trail/sidewalk improvements do not relate to this criterion. This criterion is not applicable.

2. Public Access. The SIRDMP specifically proposes to improve public access, not only through the provision of physical improvements, such as sidewalks and signing, but also by providing viewpoints adjacent to the river where the viewing experience will be specifically enhanced. Public access to the river, including views of the river and working harbor, will be enhanced, meeting this criterion.

3. Natural Riverbank and Riparian Habitat. Fishman Environmental, working for the applicant, identifies Swan Island as having a number of different quality habitats (Swan Island Riverbank Development Plan Wildlife Habitat Inventory, Exhibit A-2). The following assessments and recommendations are presented by Fishman Environmental in the above document, the eleven site numbers correspond to sites identified in Figure 1 of the above report. The Lower Willamette River Wildlife and Habitat Inventory (LWRWHI), Bureau of Planning, 1986, habitat ratings are also given (in parentheses).

SITE	ASSESSMENT	RECOMMENDATION
1. Channel Module Site (LWRWHI:n/a)	Fishman Habitat Rating 33. Aquatic and riparian attributes rated low to medium value.	Because of the ongoing moorage activities, heavy (large) rip rap bank treatment, and lack of visibility from the river (ships are typically moored along this section of the river bank), because
2. PSY Main Parking Lot (LWRWHI:22)	Fishman Habitat Rating 33. Similar to Site 1, aquatic and riparian attributes rated low to medium value.	enhancement here would create little improvement in habitat or appearance, and because extensive enhancement of the habitat at the foot of the Lagoon will provide significant mitigation, these areas should remain as is.

3. Berths 313/314 (LWRWHI:16)	Fishman Habitat Rating 14. Berth pilings provide some habitat for fish and other aquatic species.	No habitat enhancement potential.
4. Between Dry Docks (LWRWHI:47)	Fishman Habitat Rating 18. No habitat, good slope stability.	No habitat enhancement potential.
5. Dry Dock Area (LWRWHI:16)	Fishman Habitat Rating 12. No habitat.	No habitat enhancement potential.
6. Berths 302-305 (LWRWHI:16)	Fishman Habitat Rating 12. No habitat.	No habitat enhancement potential.
7. Berths 306-308 (LWRWHI:28)	Fishman Habitat Rating 17. Limited enhancement potential.	Plant and promote the establishment of riparian trees and shrubs, such as willow and cottonwood.
8. Berth 309 (LWRWHI:28)	Fishman Habitat Rating 29. The small area of riparian habitat (trees and shrubs) is a good example of what can be done with appropriate study area shorelines to improve habitat values.	Maintain vegetation and remove Scot's broom and Himalayan blackberries.
9. End of Lagoon (LWRWHI:n/a)	Fishman Habitat Rating 22. Restoration potential medium; suitability for park high.	Plant and promote the establishment of riparian trees and shrubs, such as willow and cottonwood along the water edge.
10. Boat Ramp (LWRWHI:75)	Fishman Habitat Rating 53. Fairly well developed riparian zone. Significant wildlife signs.	Maintain desirable vegetation and remove Himalayan blackberry and reed canary grass. Plant native riparian vegetation.
11. Lifeflight (LWRWHI:22)	Fishman Habitat Rating 54. Fairly well developed riparian zone. Significant wildlife signs.	Maintain desirable vegetation and remove Himalayan blackberry and reed canary grass. Plant native riparian vegetation.

In order to be in compliance with this guideline, the applicant is required to preserve and enhance natural banks and areas with riparian habitat. This applies to situations where the river bank is in a natural state, or has significant wildlife habitat, as determined by the wildlife habitat inventory. Among the sites controlled by the applicant, only Site 10 is identified by the wildlife habitat inventory as having significant habitat. Site 9, adjacent to Site 10, can provide a significant complement to Site 10. In order to comply with this guideline, enhancement of Sites 9 and 10, as recommended by Fishman Environmental Services (Exhibit A-2), is necessary.

4. Riverbank Stabilization. The proposed improvements will not adversely affect riverbank stabilization and can improve stabilization. Requirements to meet the recommendations of Fishman Environmental Services regarding Sites 9 and 10 will provide additional riverbank stabilization through the use of native vegetation. With the conditions of approval recommended to comply with the preceding approval criterion (No. 3, above), this criterion can be met.

5. Landscape Treatments. A balance is achieved between the needs of the human and wildlife populations. In this area of river-dependent heavy industry it is appropriate that the balance should sway somewhat towards the human needs, but not so much as to forego all opportunities to provide habitat. With the addition of the landscape enhancements discussed above, this criterion is met.

6. Alignment of Greenway Trail. The Greenway Trail designation does not fall within this site. This guideline is not applicable.

   However, there will be sidewalk improvements providing greater opportunity for access to the river and the planned viewpoints.

7. Viewpoints. The 1979 Greenway Plan identifies a viewpoint within the University of Portland Campus that corresponds to one of the four viewpoints being considered by the applicant in this plan. City documents do not identify any viewpoints within the SIRDMP district. However, two viewpoints will be constructed as partial compliance with the preceding approval criteria. This guideline is not applicable.

8. View Corridors. There are no designated view corridors within the SIRDMP district. This guideline is not applicable.

33.805.040 ADJUSTMENT APPROVAL CRITERIA

Adjustment requests will be approved if the review body finds that the applicant has shown that approval criteria A. through E. stated below have been met.

The applicant is requesting adjustment for non conforming base zone landscaping standards for individual sites throughout the Plan District. In some instances relief from the requirement is proposed and in some instances alternative landscaping or screening is proposed. In other cases the applicant proposes to comply; the latter will not be discussed here.

The applicant identifies the specific adjustment requests in Exhibit A-1, pages 20-29. Following is a summary:

1. Channel Module Site, non conforming perimeter landscaping presently consists of six-foot high slatted chain link fence and 31 trees. Request: Adjustment/deferral of update until redevelopment of site occurs.

2. Main PSY Parking Lot Site, non conforming perimeter and interior landscaping presently consists of six-foot high chain link fence, three-foot high hedge (for most of street frontage), 12 trees, and 26 landscape islands (with very little vegetation). Request: Adjustment of height of perimeter vegetation (At request of Portland Police for improved visibility, Appendix 3, Exhibit A-1), reduction of perimeter trees required from 47 to 22, and elimination of interior landscape requirement (At request of Portland Police for improved visibility, Appendix 3, Exhibit A-1).

3. Berths 314-315, non conforming perimeter screening presently consists of a six-foot high chain link fence. Request: Adjustment to eliminate requirement for 100 percent sight obscuring on basis that same owner exists on both sides of fence and fence needs to be removable for marine related activities.

4. Berths 306-308 and Foss Environmental, Foss Environmental has non conforming perimeter screening presently consisting of six-foot high fence. Request: Adjustment to eliminate requirement for 100 percent site obscuring fence for truck storage and elimination of all required street/site perimeter screening.

5. Main Ship Yard, non conforming interior parking lot landscaping. Request: Adjustment to substitute six identified landscape sites (More than 1,000 square feet of landscaping) for required landscaping (Based on number of cars, up to 20,000 square feet of landscaping), based on the need to rearrange the internal configuration of the ship yard for different jobs and the resultant "informal" nature of any parking area.

6. Commercial Office Machines, applicant no longer controls this property.

7. Risberg Truck, non conforming perimeter, interior and site landscaping consists of a six-foot high chain link fence, seven trees, and approximately five percent of site landscaped. Request: Adjustment to defer site landscaping until redevelopment, to allow existing 10-foot setback to continue instead of 25-foot (which is stated to be not necessary), eliminate F1 fence along property line between two similar uses, and eliminate interior parking lot landscaping because it would require digging up existing blacktop.

8. Berth 311, non conforming screening between uses. Request: Adjustment to allow elimination of F1 screening between similar use.

9. Lifeflight Property, property will comply.

A. Granting the adjustment will equally or better meet the purpose of the regulation to be modified; and

Findings:
Site 1. New use/development of site may dictate a different configuration of site and site landscaping. Existing perimeter screening for this unused site does obscure views of site, meeting purpose of: site perimeter setback landscaping, which is to separate uses from the street and provide air, light and privacy; the screening requirements for addressing unsightly interior features; and screening for truck parking and/or storage of which are not there now. This criterion is met for Site 1.

Site 2. Need for police observation combined with existing and proposed perimeter landscaping meets the purpose of the parking lot landscaping requirements, which include: general appearance and appearance from adjacent sidewalks or streets, directing traffic, shading and cooling, and controlling pollution. The proposed improvements, justified in part by the police concerns for observation, must also include the lighting increase, and removal of the slats in the fence as requested by the letter from the police (Exhibit A-1, Appendix 3).

Site 3. The existence of a site obscuring fence between two portions of the same industrial activity is not necessary to meet the purpose of the work activities requirements, which are: consistent character of the area, general appearance, effect on adjacent property, and effect on the environment. This criterion is met for Site 3.

Site 4. The applicant identifies the "voluntary public improvement package" as mitigation for the absence of certain site perimeter landscaping or screening requirements. Given that the shipyard and port support facilities found on Swan Island do appear and most frequently function as a part of the larger whole, the idea of district-wide mitigation is supportable. The new landscaping and habitat enhancement to occur at the foot of the lagoon will greatly improve the image of the plan district as a whole, and provide a restored habitat for wildlife. There is sufficient mitigation in terms of landscaping provided elsewhere, to meet the purpose of the code when looking at the plan district as a whole. This criterion is met for Site 4.

Site 5. The constantly changing configuration of the ship yard activities, the fact that the Main Ship Yard parking areas are well screened by surrounding buildings, The new Main Ship Yard parking lot will be landscaped in accordance with the applicant's plan (Exhibit A-5), plus additional site landscaping as proposed, meets the purpose for parking lot landscaping. This criterion is met for Site 5.

Site 6. Not relevant.

Site 7. All site non conforming landscaping features, for the Risberg Truck Site, can be appropriately deferred until this site redevelops. However, to be able to comply with this criterion this site must comply with the applicable development standards at the time of redevelopment.

Site 8. The need to screen between two similar uses has been established by the code for the purpose of consistency with the overall character and appearance of the zone and area, and to protect residential properties and the environment. The appearance of the zone and area is being enhanced by other improvements in this proposal, and there are no residential or environmental zones affected by this site. This criterion is met for Site 8.

Site 9. Will comply, not relevant.

B. If in a residential zone, the proposal will not significantly detract from the livability or appearance of the residential area, or if in a C, E, or I zone, the proposal will be consistent with the desired character of the area; and

Findings: The desired character of the industrial sanctuary zones (IH, IG1 and IG2) is to provide a place where uses recognized as having a less than appealing character can locate, so long as a safe, functional, efficient, and environmentally sound development occurs. None of the proposed adjustments will create a conflict with the desired character of the area, nor create any significant difference between the uses involved. This criterion is met for all adjustments proposed.

C. If more than one adjustment is being requested, the cumulative effect of the adjustments results in a project which is still consistent with the overall purpose of the zone; and

Findings: The numerous adjustments requested will, in combination, reduce the aesthetic background of the Swan Island industrial district area; however, other aesthetic improvements are being proposed at the same time, more than mitigating for the proposed reductions in landscaping and screening. Given this and the lack of aesthetic intent in the industrial sanctuary zones, this criterion is met.

D. City-designated scenic resources are preserved; and

Findings: There are no City-designated scenic resources. This criterion is not applicable.

E. Any impacts resulting from the adjustment are mitigated to the extent practical; and

Findings: The impacts of reduced landscaping and screening in specific areas is mitigated by aesthetic improvements within the same general area (Swan Island), mitigating for any impacts. This criterion is met.

33.262: OFF-SITE IMPACTS

33.262.020 Applying These Regulations

Nonresidential uses in all zones which cause off-site impacts on uses in the R, C, and OS zones are required to meet the standards of this chapter. Exempted equipment and facilities are stated in 33.262.030 below.

33.262.030 Exemptions

The off-site impact standards do not apply to machinery, equipment, and facilities which were at the site and in compliance with existing regulations at the effective date of these regulations. Any new or additional machinery, equipment, and facilities must comply with the standards of this chapter. Documentation is the responsibility of the proprietor of the use if there is any question about when the equipment was brought to the site.

33.262.060 Vibration

A. **Vibration standard.** Continuous, frequent, or repetitive vibrations which exceed 0.002g peak may not be produced. In general, this means that a person of normal sensitivities should not be able to feel any vibrations.

B. **Exceptions.** Vibrations from temporary construction and vehicles which leave the site (such as trucks, trains, airplanes and helicopters) are exempt. Vibrations lasting less than 5 minutes per day are also exempt. Vibrations from primarily on-site vehicles and equipment are not exempt.

Findings: While there are vibrations associated with the existing ship repair facility, the implementation of this plan or adjustments will have no affect on vibrations. This criterion is not applicable.

33.262.070 Odor

A. **Odor standard.** Continuous, frequent, or repetitive odors may not be produced which exceed scentometer No. 0. The odor threshold is the point at which an odor may just be detected. The scentometer reading is based on the number of clean air dilutions required to reduce the odorous air to the threshold level. Scentometer No. 0 is 1 to 2 dilutions of clean air.

B. **Exception.** An odor detected for less than 15 minutes per day is exempt.

Findings: The proposed mitigation plan and adjustments do not relate to the creation of odors. This criterion is not applicable.

33.262.080 Glare

A. **Glare standard.** Glare is illumination caused by all types of lighting and from high temperature processes such as welding or metallurgical refining. Glare may not directly, or indirectly from reflection, cause illumination on other properties in excess of a measurement of 0.5 foot candles of light.

B. **Strobe lights.** Strobe lights visible from another property are not allowed.

Findings: The proposed mitigation plan and adjustments do not relate to glare or lighting, except inasmuch as landscaping may screen lighting. This criterion is not applicable.

B. DEVELOPMENT STANDARDS

Unless specifically required in the approval criteria listed above, this proposal does not have to meet the development standards in order to be approved during this process. The development standards relevant to this proposal have been discussed above.

C. PLANS AND POLICIES

Transportation Element of the Comprehensive Plan
Ordinance No. 165851, passed by the City Council on September 23, 1992, resulted in an updating of the City Arterial Streets Classification Policy (ASCP) and an amendment to Title 33, the Portland Zoning Code. In reviewing land use requests done as Goal Exceptions, Comprehensive Plan Map Amendments, Zone Changes in compliance with the Comprehensive Plan, Conditional Uses and Master Plans, the Transportation Goal (Goal 6) and Policies 6.1 through 6.25, the District Policies, the Classification Descriptions, and the Maps are used as mandatory approval criteria.

Transportation Planning Rule
Portions of the State Transportation Planning Rule became directly applicable to land use decisions and limited land use decisions May 6, 1994. Applicable provisions address pedestrian and bicycle facilities, transit improvements, and reduced dependence on the automobile. These provisions will apply directly to land use decisions until such time that the City amends its Planning and Zoning, and Subdivision regulations to comport with state standards.

Findings: The Office of Transportation, specifically the Bureaus of Transportation Planning and Transportation Engineering (Exhibits E-4 and E-5, respectively) have commented that the streets within the plan district are not fully developed. Additional sidewalk development has been recommended, providing for sidewalks on both sides of the streets within the plan district, including: North Basin, Channel, Anchor, Dolphin and Lagoon. However, the issue of retroactive street improvements will be dealt with through the building permit process.

The Bureau of Planning staff notes that this proposal does not result in any increase in automobile or truck traffic or change in traffic patterns, it does result in an improved pedestrian system, an improved recreational trail system, and improved aesthetics for Swan Island. Accept and only inasmuch as the recreational trail system improvements also improve the public pedestrian system, the Transportation Element of the Comprehensive Plan and the State Transportation Planning Rule do not apply to this proposal.

III. CONCLUSIONS

The proposed Swan Island Riverbank Development Mitigation Plan (SIRDMP) is in compliance with the approval criteria of Section 33.585.050, Swan Island Plan District - Landscaping Within the Greenway Setback. Ongoing development of the concept of viewpoints/interpretive centers is reasonable only in the context of returning "final design" decisions to the public procedures for review and final approval. The "final design" of such facilities must take into account and be guided by criteria for development. In the absence of any such criteria established by the applicant, the staff recommends development criteria.

The adjustments requested are approvable through mitigation and/or the extent of existing landscaping screening provided. The need for police observation of a particularly troublesome parking lot (PSY Main Parking Lot) warrants changes to the landscaping requirements; landscaping should be reduced to accommodate observation of the parking lot from the street. The overall improvements to the aesthetics of the Swan Island Plan District provides mitigation for the adjustments requested.

In response to the staff's recommendation that amendments to this plan be reviewed through a Type III procedure, the applicant has argued (Exhibit A-7) that amendments to this plan should be reviewed through Type I (minor) or Type II (other) procedures. To be consistent with the way such plans are treated in the Planning and Zoning Code (Examples: Chapter 33.815, Conditional Uses; Chapter 33.820, Master Plans; Chapter 33.560, North Cully District Plan) and to accommodate the need for typically frequent modifications to the make-up of the PSY and general Swan Island industries, there should be less involved options for amendments of a less involved nature.

Lastly, the Office of Transportation has identified improvements to the street system, mainly sidewalks, that are necessary to bring Swan Island into conformance with the Arterial Streets Classifications. However, the extent of the required changes are well beyond any proportional need and even a qualifying land use nexus is difficult to ascertain in most instances. In light of this analysis, the Bureau of Planning staff recommends that the proposed street improvements be a matter for the Office of Transportation to consider at the time of building permit request.

IV. TENTATIVE STAFF RECOMMENDATION (may be revised upon receipt of new information at any time prior to the Hearings Officer's decision)

Approval of the Swan Island Riverbank Development Mitigation Plan and elimination of Greenway Reviews within the Swan Island Plan District. for a period of 10 years, subject to the following conditions:

A. Amendments to this plan, if necessary during the 10 year life of this plan, will be reviewed through a Type I review for changes that affect 10 percent or less of the area (quantity) of approved improvements, or are temporary changes (As defined by Chapter 33.296, Temporary Activities), that comply with all conditions of approval; and a Type II review for other changes. Update of the Plan at the end of the 10 year period, will be reviewed through the Type III procedures, and will be subject to the approval criteria of Section 33.585.050.

B. All landscaping proposed within the Portland Ship Yard, at the entrance to the ship yard, and along Lagoon Avenue (Exhibit A-1) must be implemented and in place by December 31, 1999.

C. The recommendations for landscape/habitat enhancement by Fishman Environmental Services (Exhibit A-2) for Site 10 (Boat Ramp Site) will be carried out as described by the Habitat Enhancement Plan (attached), included in Exhibit A-7, by December 31, 1998.

D. The applicant will apply for a Type II review for approval of specific/final viewpoint/interpretive center design within six months of this approval. This application will respond to the following:

1. Three viewpoint/interpretive centers will be developed. The two identified undeveloped viewpoints will be given priority consideration over the existing viewpoints for development/enhancement, a decision not to develop either of the two identified undeveloped viewpoints must be accompanied by a complete rationale; and

2. Viewpoint/interpretive center design will take into account all of the following considerations: weather protection, instructional/historical/topical information, seating, lighting, integration with immediate surrounding (including: design, materials, colors, landscaping), common elements and/or diversity, and signage.

Approval of the adjustment for perimeter landscaping and screening of Site 1, Channel Module Site, as identified in Exhibit A-1, pages 20-29.

Approval of the adjustment to allow for modification of the height (growing) standards of the perimeter landscaping, leaving opportunity for observation by police from Channel Avenue, and reduction of required perimeter trees from 47 to 22 for Site 2, Main PSY Parking Lot Site, subject to the following conditions:

A. Low growing plant materials need be no higher than 30-inches in height, and may be shorter; trees may display a branching pattern or habit that does not include branches below six feet (approximately), or tightly columnar trees may be used.

B. Lighting of this parking lot will be in accordance with the identified needs of observation, a letter indicating acceptance by the Portland Police of the new level of lighting will accompany the building permit request.

C. Remove the wooden slats in the north and west perimeter fence.

Approval of an adjustment to allow interior parking lot landscaping to occupy only the existing landscape islands, within Site 2, Main PSY Parking Lot Site, with planting accommodating observation by police from Channel Avenue (i.e., low growing shrubs and trees with a higher branching pattern).

Approval of an adjustment to allow elimination of the required F2 fencing between Site 3, Berths 314 and 315, and the Main PSY Parking Lot.

Approval of the adjustment to eliminate the required street frontage landscaping for Site 4, Foss Environmental.

Approval of an adjustment eliminating all required interior parking lot landscaping for the parking within Site 5, Main Ship Yard, subject to the following condition:

A. All site landscaping and all New Parking Lot landscaping proposed by the applicant will be will be carried out as described in Exhibits A-1 and A-5, by December 31, 1998.

Approval of the adjustment to eliminate all required interior parking lot landscaping for Site 7, Risberg Truck and of the adjustment to eliminate the required F1 screening along the interior property line, subject to the following condition:

A. This site must comply with the applicable development standards at the time of redevelopment.

Approval of the adjustment to eliminate the requirement for a partially sight obscuring fence (F1 screening) for Site 8, Berth 311.

NOTES: The following are not conditions of this approval, but have been noted as requirements that will be imposed by City bureaus at the time building permits are issued or final plat is approved.

1. The Office of Transportation has expressed the need for street improvements including sidewalks on both sides of the following streets: North Basin, Anchor, Lagoon, Dolphin and Channel. These improvements may be required at the time of building permit request.

==================================

The application for this land use review was determined to be complete on December 24, 1996. However, at the applicant's request, the hearing scheduled for February 18, 1997 was set over until amendments could be made to the proposal.

This report is not a decision. The review body for this proposal is the Hearings Officer who will make the decision on this case. This report is a recommendation to the Hearings Officer by the Bureau of Planning. The review body may adopt, modify, or reject this recommendation. The Hearings Officer will make a decision within 17 days of the close of the record. Your comments to the Hearings Officer should be mailed c/o Land Use Hearings Officer, 1120 SW 5th, Room 1017, Portland, Oregon 97204 or FAX your comments to (503) 823-4347.

You will receive mailed notice of the decision if you write a letter received before the hearing or testify at the hearing, or if you are the property owner or applicant. You may review the file on this case at our office on the 10th floor of the Portland Building, 1120 SW Fifth Avenue; Portland, Oregon.

Appeal of the decision. The decision of the review body may be appealed to City Council, who will hold a public hearing. If you or anyone else appeals the decision of the review body, only evidence previously presented to the review body will be considered by the City Council.

Who can appeal: You may appeal the decision only if you write a letter which is received before the close of the record on hearing or if you testify at the hearing, or if you are the property owner or applicant. Appeals must be filed within 14 days of the decision. **An appeal fee of $2,055.75 will be charged (one-half of the application fee for this case).**

Neighborhood associations and low-income individuals may qualify for a waiver of the appeal fee. Additional information on how to file and the deadline for filing an appeal will be included with the decision. Assistance in filing the appeal and information on fee waivers are available from the Bureau of Planning in the Permit Center in the Portland Building at 1120 SW 5th, 1st floor. Fee waivers for low income individuals must be approved prior to filing your appeal; please allow 3 working days for fee waiver approval. Fee waivers for neighborhood associations require a vote of the authorized body of your association. Please see appeal form for additional information.

Recording the final decision. If this proposal is approved, it must be recorded at the City Auditor's office. The applicant, builder, or their representative can record the decision by going, in person, to the City Auditor's office at the Interim City Hall, 1400 SW Fifth Avenue, Room 401; Portland, Oregon. The Auditor will charge a fee, and will record this decision with the County Recorder. All land use reviews, except those for **only** a Subdivision and/or Planned Unit Development (PUD), must be recorded in this manner. Building or development permits will be issued only after this decision is recorded.

Expiration of the approval. The recorded decision expires three years from the recording date unless:

- A building permit has been issued, or
- The approved activity has begun, or
- In situations involving only the creation of lots, the land division has been recorded.

Applying for your permits. A building permit, occupancy permit, or development permit must be obtained before carrying out this project. At the time they apply for a permit, permittees must demonstrate compliance with:

- All conditions imposed here.
- All applicable development standards, unless specifically exempted as part of this land use review.
- All requirements of the building code.
- All provisions of the Municipal Code of the City of Portland, and all other applicable ordinances, provisions and regulations of the city.

If you have a disability and need accommodations, please call 823-7700 (TDD: 823-6868). Persons requiring a sign language interpreter must call at least 48 hours in advance.

Steve Gerber

EXHIBITS
NOT ATTACHED UNLESS INDICATED

A. Applicant's Statements
   1. Request for Approval of Swan Island Riverbank Development Mitigation Plan
   2. Swan Island Riverbank Development Mitigation Plan Wildlife Habitat Inventory
   3. Legal Description and Tax Account Numbers (attached)
   4. Addendum: Main Shipyard Entrance Landscaping
   5. Addendum: New Shipyard Parking Lot Landscaping

   (Revised Proposal)

   6. Memorandum of Changes (4/21/97)
   7. Amendment to the Proposed Swan Island Riverbank Development Mitigation Plan (5/97, excerpt attached)

B. Zoning Map (attached)

C. Site Plan (attached)

D. Notification information:
   1. Posting letter sent to applicant
   2. Notice to be posted
   3. Applicant's statement certifying posting
   4. Mailed notice
   5. Mailing list

   (Second notification)

   6. Posting letter sent to applicant (5/30/97)
   7. Revised Notice to be posted
   8. Applicant's statement certifying posting (6/9/97)
   9. Mailed notice, revised (6/23/97)
   10. Mailing list, revised notice

E. Agency Responses:
   1. Bureau of Buildings
   2. Bureau of Environmental Services
   3. Bureau of Traffic Management
   4. Transportation Planning Section of the Office of Transportation
   5. Bureau of Transportation Engineering
   6. Tri-Met

   (Responses after postponement of hearing)

   7. Fire Prevention Division (6/19/97)
   8. Transportation Planning Section of the Office of Transportation (2/14/97)
   9. Bureau of Environmental Services (6/23/97)
   10. Bureau of Buildings (6/6/97)
   11. Bureau of Buildings, Code Enforcement (6/3/97)
   12. Tri-Met (2/13/97)
   13. Bureau of Transportation Engineering (7/1/97)
   14. Bureau of Traffic Management (6/16/97)
   15. Transportation Planning Section of the Office of Transportation (6/23/97)

F. Letters
   1. Halvorsen/Peterson/Shuford (2/9/97)

G. Other
   1. Response from Port to Tri-Met Comments
   2. Update of Port's Ongoing Public Involvement and Response to Office of Transportation Comments
   3. Applicant's Request for Postponement (2/14/97)
   4. Cover Letter for Applicant's Revisions (6/10/97)

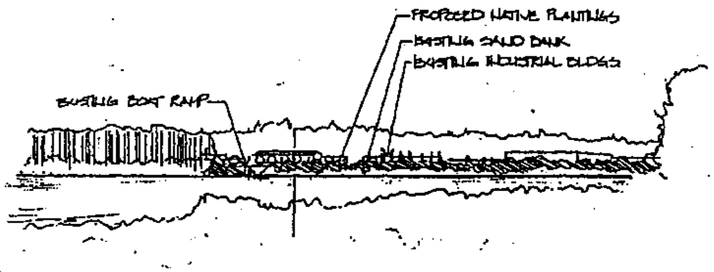
Legal Description and Tax Account Numbers of Property Within Swan Island Plan District

Legal Description
Section 17 1N 1E Tax Lots 17, 25, 28 36, 38, 41, 42, 43, 53, 63, 64, 65, 67, 69, 71, 77, 79, 80, 82, 84, 85, 81, 103, 105, 107, 112, 114, 116, 117, 118, 127, 128, 130, 132, 133, 590, 600
Section 20 1N 1E Tax Lots 107, 110, 114, 117
Section 21 1N 1E Tax Lots 81, 84, 88, 89, 92, 95, 99,104, 107
Partition Plat 1990-69 lot 3
Partition Plat 1990-69 Tax Lot 1 of lot 1
Partition Plat 1994-175 Parcel 200 Lot 1
Partition Plat 1994-175 parcel 300 Lot 2
Partition Plat 1994-175 Lot 1 (Formerly Lot 3)
Partition Plat 1995-139 Lot 2 (Formerly with aforementioned Lot 3)

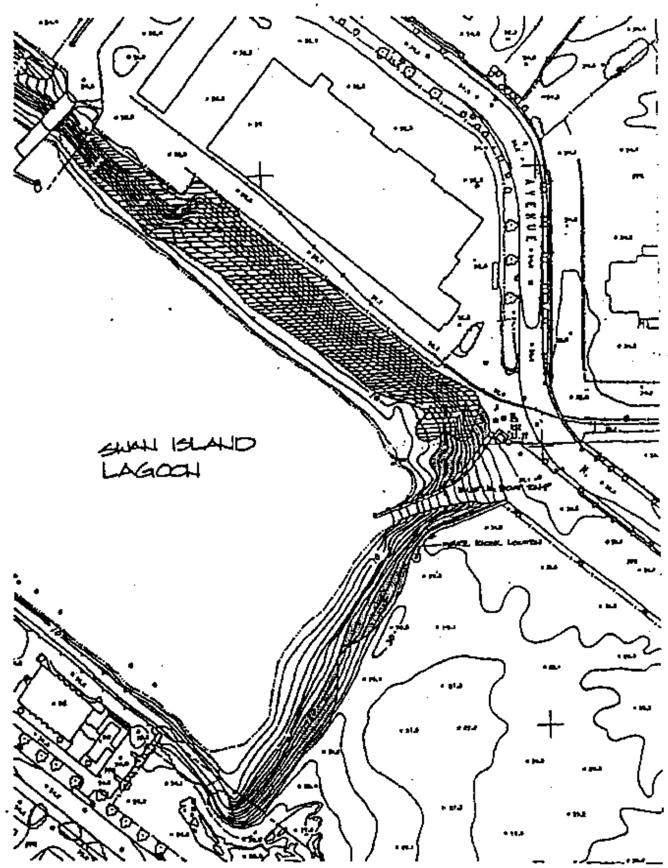
Tax Account Numbers
R941171320, R941171320, R941171300, R941171270, R941170750, R941170790, R941170810, R941170800, R941170820, R941170770, R941170760, R941170280, R941170530, R941171180, R941170410, R941170420, R941170840, R941170630, R941170850, R941170640, R941170650, R941170690, R941170430, R941170710, R941170670, R941170380, R941201140, R941201170, R941201070, R941210840, R941201070, R941210810, R941211040, R649704140, R941170170, R941171050, R941170360, R941170250, R941171280, R941201160, R941201150, R941200930, R941201100, R941171030, R941171120, R941170600, R941170590, R941201100, R941210880, R941211070, R941210990, R941210950, R941200920, R649714970, R649746980, R649755360, R649755370

LUR96-01086

A-3



Concept Perspective



Planting Plan
1" = 100'

Willow Thicket Plant List

Trees		
Alnus rubra	5-6' Cont.	15
Crataegus douglasii 'douglasii'	5-6' Cont.	15
Fraxinus latifolia	5-6' Cont.	15
Shrubs		
Cornus stolonifera	24-36"	60
Oemleria cerasiformis	24-36"	20
Rosa pisocarpa	24-36"	40
Salix sitchensis	24-36"	80
Spiraea douglasii	24-36"	20
Ground Covers		
Elymus glaucus	10 lbs./Acre, Hydro-seed	
Festuca rubra 'Rubra'	6 lbs./Acre, Hydro-seed	
Lupinus bicolor	2 lbs./Acre, Hydro-seed	
'Regreen' (Cover Crop)	5 lbs./Acre, Hydro-seed	

Key

Willow Thicket 0.7 Acres
Existing Vegetation (Remove non-native vegetation) 2 Acres

Planting Notes:

1. Plantings will be watered for a 5 year period using an automatic irrigation system.
2. Plants shall be planted informally in natural groupings which best conform to the existing topography and existing site features.
3. Remove non-native vegetation, replant Willow Thicket zone with plants specified.

NO.	DATE	BY	REVISIONS	CK'D	APP'V'D	NO.	DATE	BY	REVISIONS	CK'D	APP'V'D

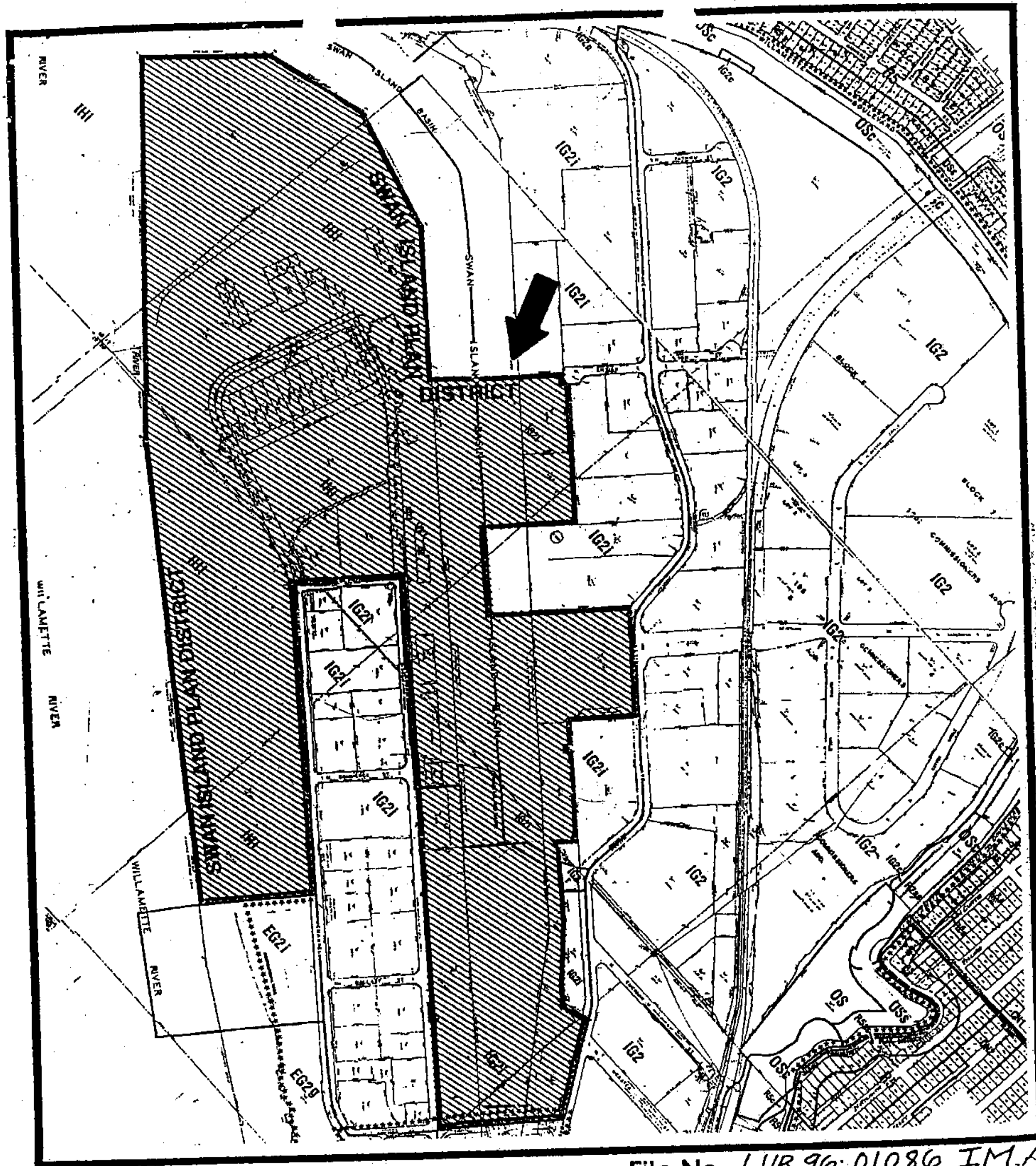
PORT OF PORTLAND
PORTLAND, OREGON

DESIGNED BY	TVW
DRAWN BY	TVW
CHECKED BY	
DATE	
SCALE	

Swan Island Industrial Park
Swan Island Riverbank Mitigation
Lagoon Site Planting Plan

SUBMITTED BY
DRAWING NO.

Exhibit
A-7
(excerpt)

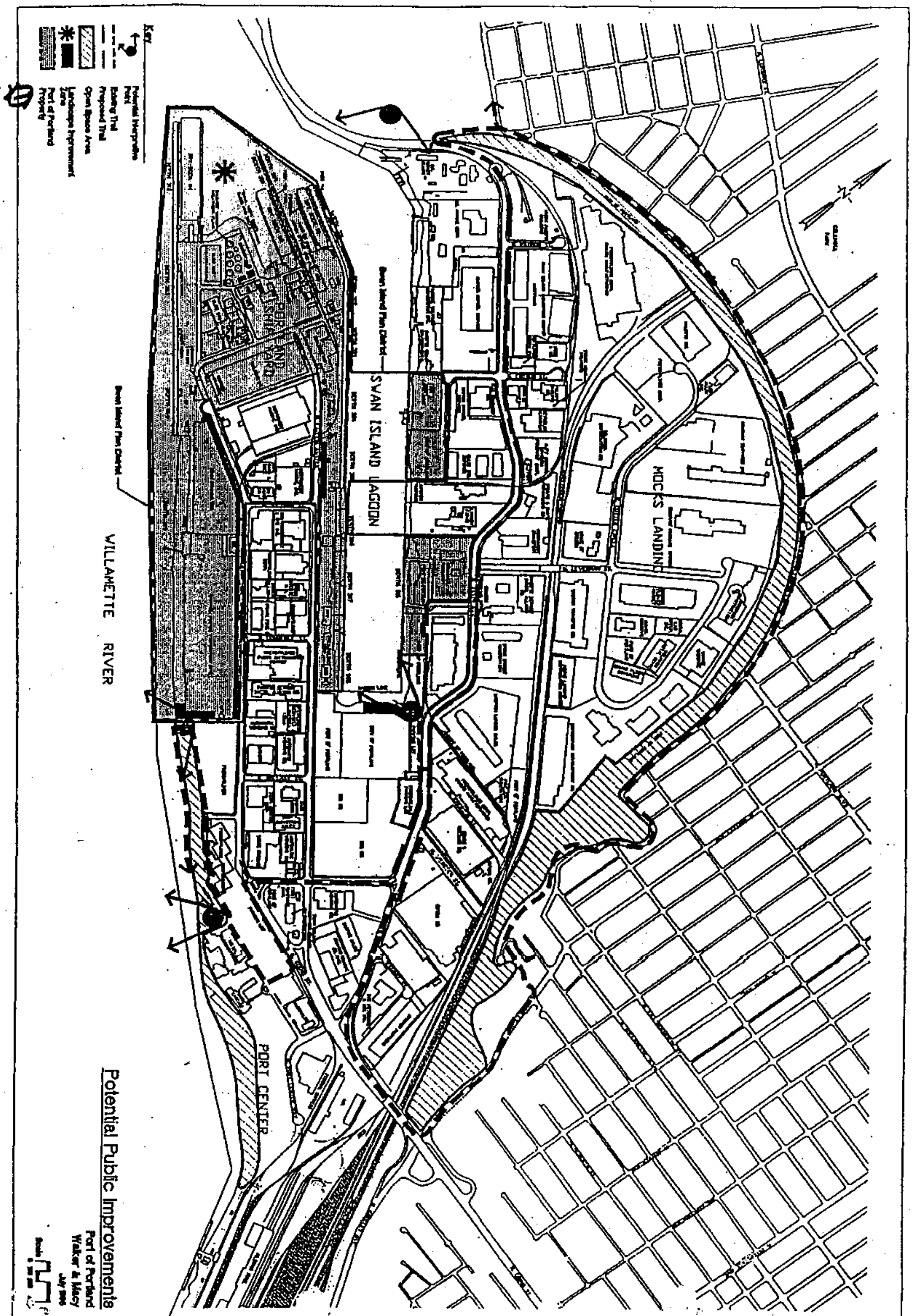


Zoning

Site

This site lies within the
SWAN ISLAND PLAN DISTRICT

File No. LUR96-01086 IM,AD
1/4 Section 2525-2527 2424-2426
Scale 1" = 800'
Request
Exhibit B



SWAN ISLAND LAGOON
MOCKS LANDING
WILLAMETTE RIVER
PORT CENTER
Potential Public Improvements
Port of Portland
Walker & Macy
Key

CHAPTER 33.585
SWAN ISLAND PLAN DISTRICT

(Added by Ord. No. 167054, effective 10/25/93. Amended by: Ord. No. 167650, effective 6/10/94; Ord. No. 174263, effective 4/15/00.)

Sections:

General
33.585.010 Purpose
33.585.020 Where the Regulations Apply
Use Regulations
33.585.030 Additional Allowed Primary Uses
33.585.040 Additional Allowed Accessory Uses
Development Standards
33.585.050 Landscaping Within the Greenway Setback
Map 585-1 Swan Island Plan District

General

33.585.010 Purpose
The Swan Island Plan District is intended to foster the continuation and growth of the Portland Ship Repair Yard. The shipyard is a primary industry dependent on the Willamette River. Activities occurring in the shipyard cover a range that runs from heavy industrial to temporary housing for the crews of ships undergoing repair or refitting. The variety of sizes and types of ships and industrial construction projects attracted to the shipyard frequently requires that the area be reconfigured. The provisions of the Swan Island Plan District are intended to foster the growth and competitiveness of this unique waterfront basic industry. The provisions of this plan district replace the Swan Island Development Program's provisions affecting the transportation and circulation components of the island's development within the plan district.

33.585.020 Where the Regulations Apply
The regulations of this chapter apply to the Swan Island Plan District. The boundaries of the plan district are shown on Map 585-1 at the end of this chapter, and on the Official Zoning Maps.

Use Regulations

33.585.030 Additional Allowed Primary Uses

A. Purpose. Because the demand for use of the ship repair facilities is not constant it is in the public interest to allow nonriver-related or nonriver-dependent activities to temporarily use the underutilized portions of the repair yard facility.

B. Additional primary uses allowed. Within the Swan Island Plan District the following construction activities that are not river-related and river-dependent are permitted: construction of modular housing, large scale metal fabrication of such things as cranes, bridge trusses and spans, platforms and derricks, and military and aeronautics machinery.

33.585.040 Additional Allowed Accessory Uses

A. Purpose. The nature of the ship repair activity brings to the site the ship's crews whose living quarters are on board vessels which are being repaired. The large size and unique nature of the activity requires more flexibility in the area of accessory use activities than are allowed by the yard's industrial zoning.

B. Additional accessory uses. The following additional accessory uses are allowed within the Swan Island Plan District.

1. Office: Temporary (up to 2 years) office trailers, office space for contractors and subcontractors, offices of naval architects, testing services and government offices.

2. Household or Group Living: Temporary (up to 2 years) housing for Navy and other vessel crews. Housing is allowed only if associated with a ship repair/refurbishing project.

3. Industrial Services: Welding, machine tooling, metalworking, carpentry, plumbing, and other building activities supporting a ship repair or other large construction project occurring in the shipyard are allowed for up to 2 years. Surface preparation and painting of ships and other equipment being constructed in the ship repair yards. Warehousing of materials and supplies needed for ship repair and fabrication projects. Exterior storage and laydown areas for ship's and contractor's equipment and supplies. Temporary storage of equipment used to cleanup or manage hazardous waste. In-ground fuel tanks and pumps for shipyard tenants. Grit storage and handling and grit recycling. Barge-mounted surface preparation and coating facilities. Temporary storage of vehicles and equipment.

Development Standards

33.585.050 Landscaping Within the Greenway Setback

A. Purpose. The Portland Ship Repair facilities are designed to allow their flexible modification and reconfiguration. This flexibility is essential both for the shipyard's ability to accommodate multiple concurrent projects and its ability to accommodate the wide variety of ship types and sizes that are attracted to its facilities. The City's greenway zone regulations assume that developed property along the Willamette will be relatively stable in its configuration and require that activities that are not water-related or water-dependent be separated from the top of the river's bank by a landscaped greenway setback. The regulations of this section are intended to accommodate the ongoing changes in facility configuration inherent in the shipyard's operations while also addressing the appearance and character of the Willamette's riverbank.

B. Alternative greenway setback landscaping requirements. As an alternative to compliance with Section 33.440.210 Greenway Setback, a riverbank development mitigation plan may be developed and implemented. Such a mitigation plan must conform with the following requirements:

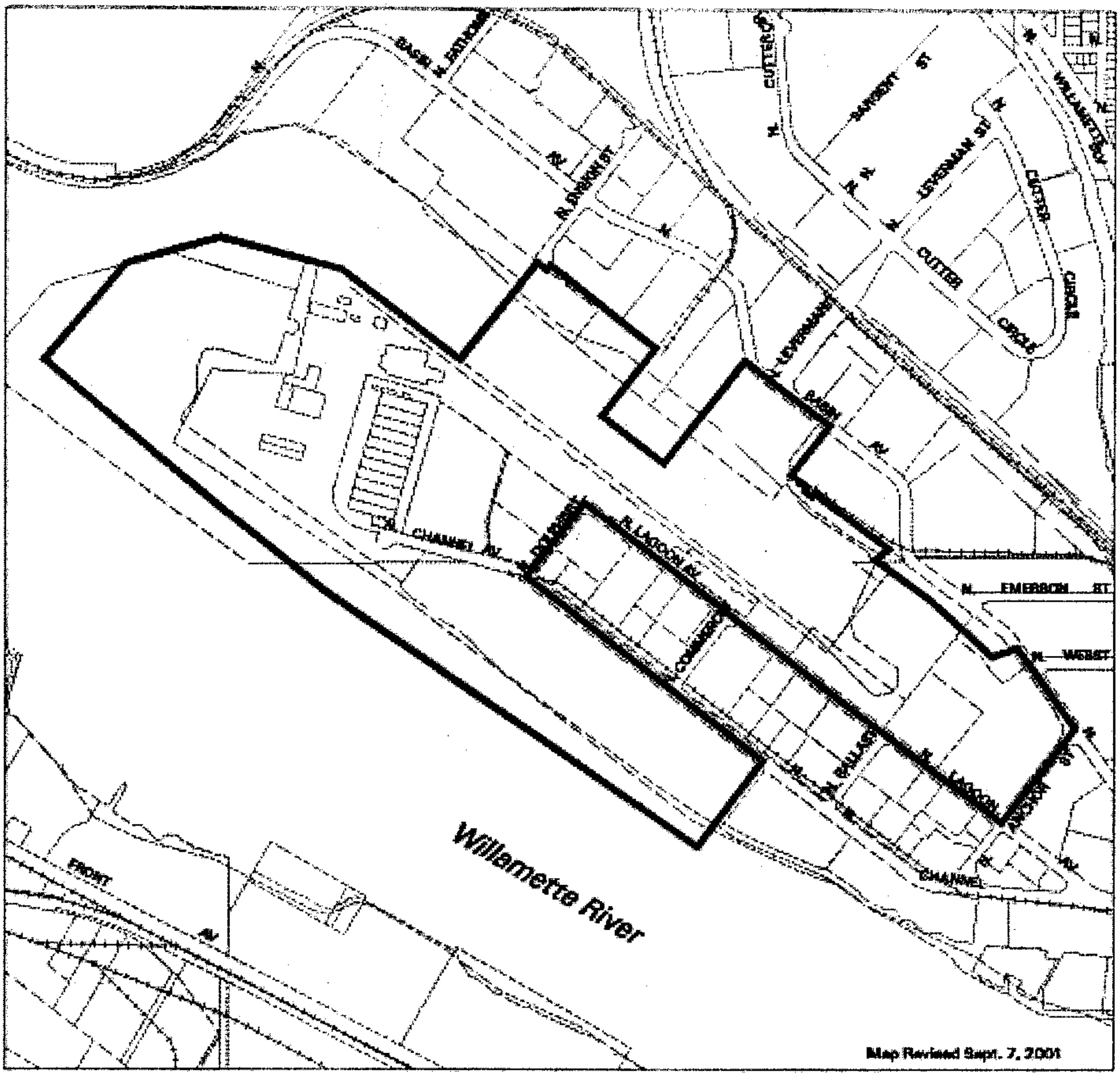
1. Procedure. The riverbank mitigation plan will be reviewed through a Type III procedure. Approval and compliance with the river-bank mitigation plan will constitute the required greenway review for building permit applications within the area covered by the mitigation plan.

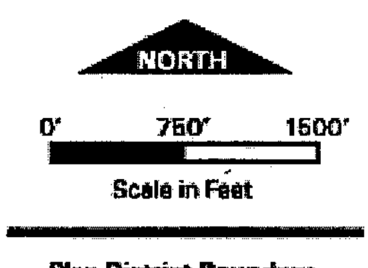
2. Approval Criteria. The approval criteria for a riverbank mitigation plan are:

   a. The mitigation plan includes a strategy for improving the appearance of the riverbank as seen from the water. Riverbank appearance improvements may include the use of landscaped areas; public art; temporary screening mechanisms; enhancement of riverbank habitat areas for fish, wildlife and native vegetation; and, establishment of locations for public access to the riverbank and river surface.

   b. The mitigation plan recognizes that views of ships and industrial construction projects are in themselves interesting and represent an enhancement of the industrial area of the Willamette.

   c. The mitigation plan meets the Willamette Greenway Design Guidelines.





Map 585-1

Swan Island Plan District

Bureau of Planning • City of Portland, Oregon

ATTACHMENT 1
Ecological Scoping Checklist for the
Swan Island Upland Facility (OU2)

Site Name	Swan Island Upland Facility (OU2)
Date of Site Visit	October 31, 2005
Site Location	5413 North Channel Avenue, Portland, OR
Site Visit Conducted by	Mark Lewis, NewFields Boulder

Part 1

CONTAMINANTS OF INTEREST **Types, Classes, Or Specific Hazardous Substances ‡** **Known Or Suspected**	**Onsite**	**Adjacent to or in locality of the facility †**
PAHs	X	
PCBs (Aroclor 1254)	X	
Metals (arsenic, cadmium, copper, lead and zinc)	X	

‡ As defined by OAR 340-122-115(30) † As defined by OAR 340-122-115(34)

Part 2

OBSERVED IMPACTS ASSOCIATED WITH THE SITE	**Finding**
Onsite vegetation (**N**one, **L**imited, **E**xtensive)	None
Vegetation in the locality of the site (**N**one, **L**imited, **E**xtensive)	None
Onsite wildlife such as macroinvertebrates, reptiles, amphibians, birds, mammals, other (**N**one, **L**imited, **E**xtensive)	None
Wildlife such as macroinvertebrates, reptiles, amphibians, birds, mammals, other in the locality of the site (**N**one, **L**imited, **E**xtensive)	None
Other readily observable impacts (**N**one, **D**iscuss below)	None
Discussion: Eight (8) acres of OU2 are developed and paved with no on-site habitat to be affected. Twenty nine (29) acres of OU2 are unpaved and undeveloped. The unpaved portions contain only ruderal vegetation (opportunistic or weedy annual species at the edge of the site consisting of opportunistic or weedy annual species. Vegetation on the riverbank below top-of-bank is dominated by Himalayan blackberry, but also contains other shrubs, grasses, and forbs	

ATTACHMENT 1
Ecological Scoping Checklist (cont'd)

Part 3

SPECIFIC EVALUATION OF ECOLOGICAL RECEPTORS / HABITAT	Finding
Terrestrial – Wooded	
Percentage of site that is wooded	0%
Dominant vegetation type (**E**vergreen, **D**eciduous, **M**ixed)	N/A
Prominent tree size at breast height, i.e., four feet (<6", 6" to 12", >12")	N/A
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds, **M**ammals, **O**ther)	N/A
Terrestrial - Scrub/Shrub/Grasses	
Percentage of site that is scrub/shrub – NOTE: Riverbank area only	14%
Dominant vegetation type (**Sc**rub, **Sh**rub, **G**rasses, **O**ther)	Sh & G
Prominent height of vegetation (<2', 2' to 5', >5')	2'-5' on riverbank
Density of vegetation (**D**ense, **P**atchy, **S**parse)	S or absent on upland; D on riverbank
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds, **M**ammals, **O**ther)	None observed
Terrestrial – Ruderal	
Percentage of site that is ruderal. NOTE: only about 5% of site has ruderal vegetation, the balance of the site from top-of-bank to N. Channel Ave is either asphalt or bare ground (graveled surface)	86%
Dominant vegetation type (**L**andscaped, **A**griculture, **B**are ground)	**B and asphalt**
Prominent height of vegetation (0', >0' to <2', 2' to 5', >5')	<2'
Density of vegetation (**D**ense, **P**atchy, **S**parse)	**S or absent on upland; D on riverbank**
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds, **M**ammals, **O**ther)	None observed
Aquatic - Non-flowing (lentic)	
Percentage of site that is covered by lakes or ponds	0%
Type of water bodies (**L**akes, **P**onds, **V**ernal pools, **I**mpoundments, **Lag**oon, **R**eservoir, **C**anal)	N/A
Size (acres), average depth (feet), trophic status of water bodies	N/A
Source water (**R**iver, **St**ream, **G**roundwater, **I**ndustrial discharge, **Su**rface water runoff)	N/A
Water discharge point (**N**one, **R**iver, **St**ream, **G**roundwater, **W**etlands impoundment)	N/A
Nature of bottom (**M**uddy, **R**ocky, **S**and, **C**oncrete, **O**ther)	N/A
Vegetation present (**S**ubmerged, **E**mergent, **F**loating)	N/A
Obvious wetlands present (**Y**es / **N**o)	N/A
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds, **M**ammals, **O**ther)	N/A

Aquatic - Flowing (lotic)	
Percentage of site that is covered by rivers, streams (brooks, creeks), intermittent streams, dry wash, arroyo, ditches, or channel waterway –**No permanent waterbody other than portion of Willamette River adjacent to upland.**	0%
Type of water bodies (**R**ivers, **S**treams, **I**ntermittent Streams, **D**ry wash, **A**rroyo, **D**itches, **C**hannel waterway)	N/A
Size (acres), average depth (feet), approximate flow rate (cfs) of water bodies	N/A
Bank environment (cover: **V**egetated, **B**are / slope: **S**teep, **G**radual / height (in feet))	N/A
Source water (**R**iver, **St**ream, **G**roundwater, **I**ndustrial discharge, **Su**rface water runoff)	N/A
Tidal influence (**Y**es / **N**o)	N/A
Water discharge point (**N**one, **R**iver, **St**ream, **G**roundwater, **W**etlands impoundment)	N/A
Nature of bottom (**M**uddy, **R**ocky, **S**and, **C**oncrete, **O**ther)	N/A
Vegetation present (**S**ubmerged, **E**mergent, **F**loating)	N/A
Obvious wetlands present (**Y**es / **N**o)	N/A
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds,	N/A
Mammals, **O**ther)	N/A
Aquatic – Wetlands	
Obvious or designated wetlands present (**Y**es / **N**o)	No
Wetlands suspected as site is/has (**A**djacent to water body, in **F**loodplain, **S**tanding water, **D**ark wet soils, **M**ud cracks, **D**ebris line, **W**ater marks)	N/A
Vegetation present (**S**ubmerged, **E**mergent, **S**crub/shrub, **W**ooded)	N/A
Size (acres) and depth (feet) of suspected wetlands	N/A
Source water (**R**iver, **St**ream, **G**roundwater, **I**ndustrial discharge, **Su**rface water runoff)	N/A
Water discharge point (**N**one, **R**iver, **St**ream, **G**roundwater, **I**mpoundment)	N/A
Tidal influence (**Y**es / **N**o)	N/A
Evidence / observation of wildlife (**M**acroinvertebrates, **R**eptiles, **A**mphibians, **B**irds, **M**ammals, **O**ther)	N/A

ECOLOGICALLY IMPORTANT SPECIES / HABITATS OBSERVED
Industrial development along the river significantly limits the habitat potential of OU2. Upland inland from top-of-bank will continue to be use for industrial or stockpiling purposes and do not represent significant habitat for any species. The riverbank area of the site is adjacent to the Willamette River which is considered important habitat by the state. The riverbank itself within the zone that would be considered riparian habitat, but it is narrow (<75 feet wide) and steep with rip-rap and debris. Vegetation is dominated with Himalayan blackberry. These factors, limit the current value of the riparian function of the area.

ATTACHMENT 2
Evaluation of Receptor-Pathway Interactions

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in surface waters? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via surface water?**		N	
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in surface waters. • Ability of hazardous substances to migrate to surface waters. • Terrestrial organisms may be dermally exposed to water-borne contaminants as a result of wading or swimming in contaminated waters. Aquatic receptors may be exposed through osmotic exchange, respiration or ventilation of surface waters. • Contaminants may be taken-up by terrestrial plants whose roots are in contact with surface waters. • Terrestrial receptors may ingest water-borne contaminants if contaminated surface waters are used as a drinking water source.			
Are hazardous substances present or potentially present in groundwater? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via groundwater?**	X		
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in groundwater. • Ability of hazardous substances to migrate to groundwater. • Potential for hazardous substances to migrate via groundwater and discharge into habitats and/or surface waters. • Contaminants may be taken-up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (□1m depth). • Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.			

"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")

ATTACHMENT 2
Evaluation of Receptor-Pathway Interactions (cont'd)

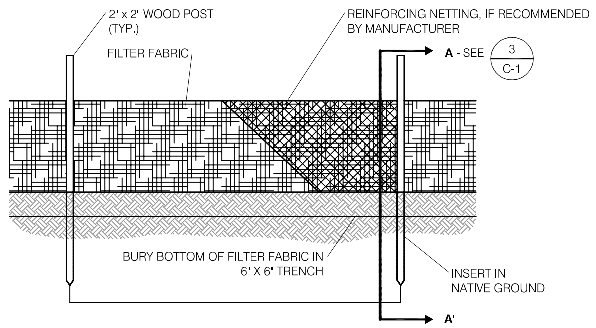
EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in sediments? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via contact with sediments?** ***NOTE: Soils and catchment sediments could be transported to the Willamette River during rainfall events via the storm drain on the south end of the site and historically, through drainpipes near the center of the site. However, there are no permanent on-site water bodies that produce sediments.***			X
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in sediment. • Ability of hazardous substances to leach or erode from surface soils and be carried into sediment via surface runoff. • Potential for contaminated groundwater to upwell through, and deposit contaminants in, sediments. • If sediments are present in an area that is only periodically inundated with water, terrestrial species may be dermally exposed during dry periods. Aquatic receptors may be directly exposed to sediments or may be exposed through osmotic exchange, respiration or ventilation of sediment pore waters. • Terrestrial plants may be exposed to sediment in an area that is only periodically inundated with water. • If sediments are present in an area that is only periodically inundated with water, terrestrial species may have direct access to sediments for the purposes of incidental ingestion. Aquatic receptors may regularly or incidentally ingest sediment while foraging.			
Are hazardous substances present or potentially present in prey or food items of ecologically important receptors? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via consumption of food items?**		X	
When answering the above questions, consider the following: • Higher trophic level terrestrial and aquatic consumers and predators may be exposed through consumption of contaminated food sources. • In general, organic contaminants with log Kow > 3.5 may accumulate in terrestrial mammals and those with a log Kow > 5 may accumulate in aquatic vertebrates.			

"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")

ATTACHMENT 2
Evaluation of Receptor-Pathway Interactions (cont'd)

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in surficial soils? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via incidental ingestion of or dermal contact with surficial soils?** ***NOTE: Current data on hazardous substances in soils suggest that receptors would not be exposed because of lack of habitat in the working areas of the site. Further sampling of beaches downgradient of drain pipe has been proposed to confirm this for downgradient areas.***		X	
When answering the above questions, consider the following: • Known or suspected presence of hazardous substances in surficial (1m depth) soils. • Ability of hazardous substances to migrate to surficial soils. • Significant exposure via dermal contact would generally be limited to organic contaminants which are lipophilic and can cross epidermal barriers. • Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces by rain striking contaminated soils (i.e., rain splash). • Contaminants in bulk soil may partition into soil solution, making them available to roots. Incidental ingestion of contaminated soil could occur while animals grub for food resident in the soil, feed on plant matter covered with contaminated soil or while grooming themselves clean of soil.			
Are hazardous substances present or potentially present in soils? **AND** **Are ecologically important species or habitats present?** **AND** **Could hazardous substances reach these receptors via vapors or fugitive dust carried in surface air or confined in burrows?**		X	
When answering the above questions, consider the following: • Volatility of the hazardous substance (volatile chemicals generally have Henry's Law constant > 10-5 atm-m3/mol and molecular weight < 200 g/mol). • Exposure via inhalation is most important to organisms that burrow in contaminated soils, given the limited amounts of air present to dilute vapors and an absence of air movement to disperse gases. • Exposure via inhalation of fugitive dust is particularly applicable to ground-dwelling species that could be exposed to dust disturbed by their foraging or burrowing activities or by wind movement. • Foliar uptake of organic vapors would be limited to those contaminants with relatively high vapor pressures. • Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces.			

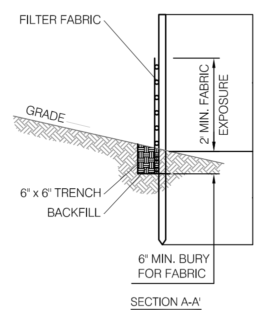
"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")



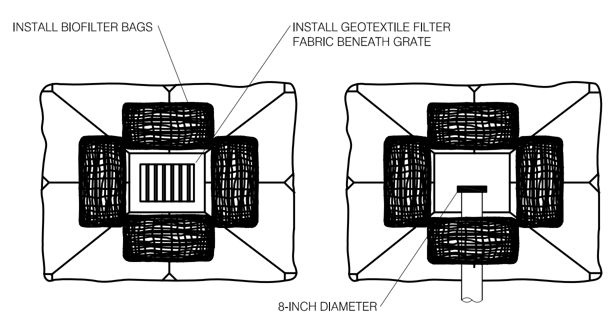
NOTES:

1. INSTALL IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.
2. FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS 36 IN. WIDE (MIN.) ROLL TO AVOID JOINTS. ATTACH TO STAKES USING STITCHED LOOPS.
3. SPLICE JOINTS AT SUPPORT POSTS ONLY, WITH A MIN. 6 IN. OVERLAP.
4. ANGLE ENDS OF SEDIMENT FENCE UPHILL TO ASSURE SOIL/SEDIMENT IS TRAPPED.

SEDIMENT FENCE DETAIL - ELEVATION 2 C-1
SCALE: NTS



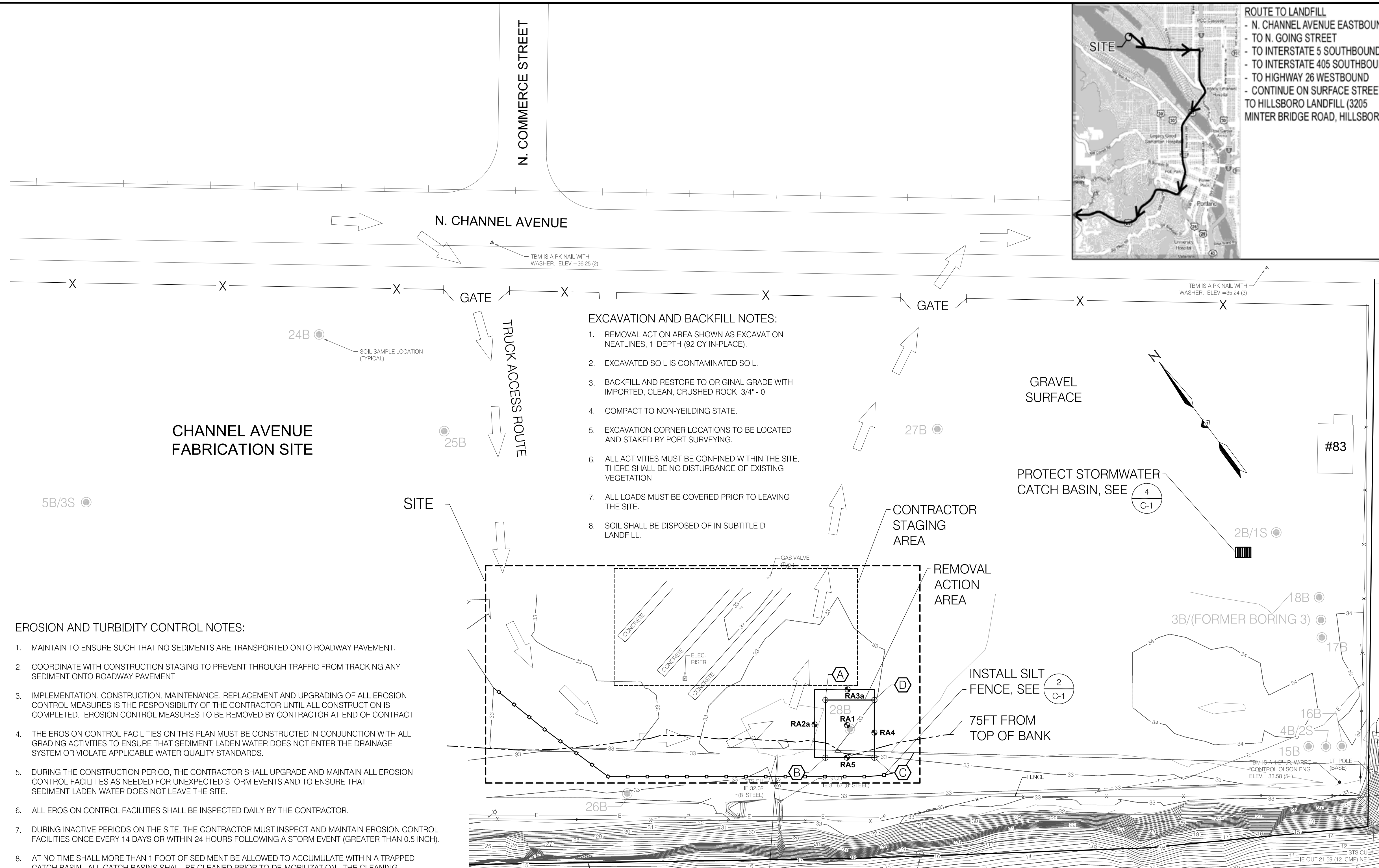
SECTION A-A' 3 C-1
SCALE: NTS



NOTE:

1. BIOFILTER BAGS SHOULD BE STAKED WHERE APPLICABLE USING (2) 1" x 2" WOODEN STAKES OR APPROVED EQUAL PER BAG.

TEMPORARY INLET PROTECTION 4 C-1
SCALE: NTS



EXCAVATION AND BACKFILL NOTES:

1. REMOVAL ACTION AREA SHOWN AS EXCAVATION NEATLINES, 1' DEPTH (92 CY IN-PLACE).
2. EXCAVATED SOIL IS CONTAMINATED SOIL.
3. BACKFILL AND RESTORE TO ORIGINAL GRADE WITH IMPORTED, CLEAN, CRUSHED ROCK, 3/4" - 0.
4. COMPACT TO NON-YEILDING STATE.
5. EXCAVATION CORNER LOCATIONS TO BE LOCATED AND STAKED BY PORT SURVEYING.
6. ALL ACTIVITIES MUST BE CONFINED WITHIN THE SITE. THERE SHALL BE NO DISTURBANCE OF EXISTING VEGETATION
7. ALL LOADS MUST BE COVERED PRIOR TO LEAVING THE SITE.
8. SOIL SHALL BE DISPOSED OF IN SUBTITLE D LANDFILL.

EROSION AND TURBIDITY CONTROL NOTES:

1. MAINTAIN TO ENSURE SUCH THAT NO SEDIMENTS ARE TRANSPORTED ONTO ROADWAY PAVEMENT.
2. COORDINATE WITH CONSTRUCTION STAGING TO PREVENT THROUGH TRAFFIC FROM TRACKING ANY SEDIMENT ONTO ROADWAY PAVEMENT.
3. IMPLEMENTATION, CONSTRUCTION, MAINTENANCE, REPLACEMENT AND UPGRADING OF ALL EROSION CONTROL MEASURES IS THE RESPONSIBILITY OF THE CONTRACTOR UNTIL ALL CONSTRUCTION IS COMPLETED. EROSION CONTROL MEASURES TO BE REMOVED BY CONTRACTOR AT END OF CONTRACT
4. THE EROSION CONTROL FACILITIES ON THIS PLAN MUST BE CONSTRUCTED IN CONJUNCTION WITH ALL GRADING ACTIVITIES TO ENSURE THAT SEDIMENT-LADEN WATER DOES NOT ENTER THE DRAINAGE SYSTEM OR VIOLATE APPLICABLE WATER QUALITY STANDARDS.
5. DURING THE CONSTRUCTION PERIOD, THE CONTRACTOR SHALL UPGRADE AND MAINTAIN ALL EROSION CONTROL FACILITIES AS NEEDED FOR UNEXPECTED STORM EVENTS AND TO ENSURE THAT SEDIMENT-LADEN WATER DOES NOT LEAVE THE SITE.
6. ALL EROSION CONTROL FACILITIES SHALL BE INSPECTED DAILY BY THE CONTRACTOR.
7. DURING INACTIVE PERIODS ON THE SITE, THE CONTRACTOR MUST INSPECT AND MAINTAIN EROSION CONTROL FACILITIES ONCE EVERY 14 DAYS OR WITHIN 24 HOURS FOLLOWING A STORM EVENT (GREATER THAN 0.5 INCH).
8. AT NO TIME SHALL MORE THAN 1 FOOT OF SEDIMENT BE ALLOWED TO ACCUMULATE WITHIN A TRAPPED CATCH BASIN. ALL CATCH BASINS SHALL BE CLEANED PRIOR TO DE-MOBILIZATION. THE CLEANING OPERATION SHALL NOT FLUSH SEDIMENT-LADEN WATER INTO THE DOWNSTREAM SYSTEM.
9. MEASURES MUST BE TAKEN BY THE CONTRACTOR WHEN NECESSARY TO ENSURE THAT ALL EXISTING PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.
10. THE MEANS AND METHODS OF THE CONTRACTOR MAY DICTATE THAT ADDITIONAL EROSION CONTROL MEASURES ARE NECESSARY. THESE ADDITIONAL MEASURES SHALL BE IMPLEMENTED AS NECESSARY TO PREVENT SEDIMENT LADEN WATER FROM LEAVING THE SITE.
11. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES.
12. A SPILL KIT IS REQUIRED TO BE MAINTAINED ON SITE TO PREVENT SPILLS OF HAZARDOUS OR HARMFUL SUBSTANCES FROM ENTERING THE STORMWATER MANAGEMENT SYSTEM. CREWS MUST BE TRAINED ON THE LOCATION AND USE OF THE KIT.
13. ALL TRUCKS SHALL BE DRY BRUSHED TO REMOVE LOOSE SOIL PRIOR TO LEAVING SITE.

POINT	EASTING	NORTHING
A	9364.89	9992.46
B	9333.16	9949.99
C	9369.21	9923.05
D	9400.94	9965.51

GRADING AND EROSION CONTROL 1 C-1
SCALE: NTS

NO.	DATE	BY	REVISIONS	CK'D	APPVD
1	12/1/05	BM	ADDED NEW CONFIRMATION SAMPLES: EXPANDED REMOVAL ACTION AREA.	JB	HFC

NO.	DATE	BY	REVISIONS	CK'D	APPVD

PORT OF PORTLAND
PORTLAND, OREGON

Ash Creek Associates Inc.
Environmental and Geotechnical Consultants
9615 SOUTHWEST ALLEN BLVD., SUITE 106
BEAVERTON, OREGON 97005
PHONE 503.924.4704
FAX 503.924.4707
www.ashcreekassociates.com

DESIGNED BY M. STEVENS
DRAWN BY J. POORE
CHECKED BY H. CLOUGH
DATE JUNE 2005
SCALE 1" = 50'

SWAN ISLAND UPLAND FACILITY
OPERABLE UNIT 2 REMOVAL ACTION
GRADING AND EROSION CONTROL

DRAWING NO. C-1

APPENDIX B
Riverbank Area Surface Soil Results

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs)		Analyte Group	Analyte	Result (mg/kg)	Qualifier
				Upper	Lower				
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	Metals	Selenium	0.5	U
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	Metals	Silver	0.5	U
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	Metals	Mercury	0.1	U
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	Metals	Lead	11.6	
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	TPH (418.1)	Heavy Oil Range Hydrocarbons	100	U
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	Metals	Chromium	12.5	
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	Metals	Cadmium	0.5	U
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	Metals	Barium	81.3	
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	PCBs_Aroclors	Aroclor 1016	0.05	U
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	PCBs_Aroclors	Aroclor 1260	0.05	U
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	PCBs_Aroclors	Aroclor 1254	0.05	U
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	PCBs_Aroclors	Aroclor 1248	0.05	U
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	PCBs_Aroclors	Aroclor 1242	0.05	U
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	PCBs_Aroclors	Aroclor 1232	0.05	U
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	PCBs_Aroclors	Aroclor 1221	0.05	U
Boring 1	PS-S-01-01	1/1/1998	grab	0	2	Metals	Arsenic	2.71	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Fluoranthene	0.032	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Phthalates	Bis(2-ethylhexyl) Phthalate	0.03	J
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Chrysene	0.027	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	TPH (NWTPH-Dx)	Oil	27	J
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Metals	Copper	33.3	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	2-Methylnaphthalene	0.023	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(g,h,i)perylene	0.064	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Benz(a)anthracene	0.023	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(a)pyrene	0.042	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Pyrene	0.046	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Low-Molecular Weight PAHs	0.07325	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(b)fluoranthene	0.061	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Metals	Zinc	246	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Naphthalene	0.023	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.046	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1260	0.053	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Metals	Arsenic	2.7	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1016	0.01	<
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Phthalates	Di-n-octyl Phthalate	0.01	<
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Dibenz(a,h)anthracene	0.021	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Phthalates	Butyl Benzyl Phthalate	0.0088	J
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Total Aroclors	0.053	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	TPH (NWTPH-Gx)	Gasoline	5.5	<
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1232	0.01	< i
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	TPH (NWTPH-Dx)	Diesel	3.2	J
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Phthalates	Dimethyl Phthalate	0.01	<
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Acenaphthylene	0.0022	J
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Phthalates	Diethyl Phthalate	0.0021	J
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Acenaphthene	0.00087	J
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Metals	Cadmium	0.763	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Fluorene	0.00068	J
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Metals	Antimony	0.37	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Anthracene	0.0035	J
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Metals	Nickel	17.9	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Metals	Lead	20.1	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1221	0.02	< i
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Dibenzofuran	0.0056	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Phenanthrene	0.02	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Metals	Silver	0.04	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Butyltins	Tributyltin	0.017	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(k)fluoranthene	0.015	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Metals	Chromium	13.8	
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1268	0.01	<
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1262	0.01	<
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	Phthalates	Di-n-butyl Phthalate	0.02	<
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1254	0.01	<
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1248	0.01	< i
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1242	0.01	< i
CG-26	RB-5 Composite	10/1/2008	composite	0	0.5	PAHs	High-Molecular Weight PAHs	0.377	
CG-26	RB-5a	10/1/2008	grab	0	0.5	Butyltins	Tributyltin	0.032	
CG-26	RB-5a	10/1/2008	grab	0	0.5	Metals	Lead	30.1	
CG-26	RB-5b	10/1/2008	grab	0	0.5	Metals	Lead	15.2	
CG-26	RB-5b	10/1/2008	grab	0	0.5	Butyltins	Tributyltin	0.0049	<
CG-26	RB-5c	10/1/2008	grab	0	0.5	Butyltins	Tributyltin	0.005	<
CG-26	RB-5c	10/1/2008	grab	0	0.5	Metals	Lead	6.94	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Phthalates	Di-n-butyl Phthalate	0.2	<
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Phthalates	Bis(2-ethylhexyl) Phthalate	0.081	JD
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Metals	Lead	42.6	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Pyrene	0.038	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Metals	Copper	57.7	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(b)fluoranthene	0.035	

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs) Upper	Lower	Analyte Group	Analyte	Result (mg/kg)	Qualifier
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	TPH (NWTPH-Dx)	Oil	75	J
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1260	0.078	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Total Aroclors	0.078	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Phthalates	Dimethyl Phthalate	0.1	<
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Phthalates	Diethyl Phthalate	0.1	<
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Phthalates	Butyl Benzyl Phthalate	0.1	<
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Butyltins	Tributyltin	0.12	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Metals	Zinc	359	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Fluoranthene	0.034	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1242	0.01	<
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Phthalates	Di-n-octyl Phthalate	0.1	<
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1254	0.01	<
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	TPH (NWTPH-Gx)	Gasoline	6.2	<
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	TPH (NWTPH-Dx)	Diesel	5.9	J
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0057	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Naphthalene	0.0056	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Metals	Arsenic	3.1	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Anthracene	0.0022	J
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1016	0.01	<
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Acenaphthylene	0.002	J
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	2-Methylnaphthalene	0.0021	J
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Metals	Cadmium	1.11	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Dibenzofuran	0.00099	J
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Fluorene	0.00093	J
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Metals	Antimony	0.27	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Metals	Silver	0.06	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Low-Molecular Weight PAHs	0.02903	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	High-Molecular Weight PAHs	0.2597	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(g,h,i)perylene	0.033	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Phenanthrene	0.015	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Acenaphthene	0.0012	J
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(a)pyrene	0.029	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Chrysene	0.026	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1221	0.02	< i
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Metals	Nickel	16.6	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.03	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	Metals	Chromium	14.9	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(k)fluoranthene	0.012	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1268	0.01	<
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1248	0.01	< i
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PAHs	Benz(a)anthracene	0.017	
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1232	0.01	< i
CG-27	RB-6 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1262	0.01	<
CG-27	RB-6a	10/1/2008	grab	0	0.5	Metals	Lead	58.2	
CG-27	RB-6a	10/1/2008	grab	0	0.5	Butyltins	Tributyltin	0.38	D
CG-27	RB-6b	10/1/2008	grab	0	0.5	Butyltins	Tributyltin	0.007	
CG-27	RB-6b	10/1/2008	grab	0	0.5	Metals	Lead	87.5	
CG-27	RB-6c	10/1/2008	grab	0	0.5	Butyltins	Tributyltin	0.0049	<
CG-27	RB-6c	10/1/2008	grab	0	0.5	Metals	Lead	33.6	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0298	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.145	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.256	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0338	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.0495	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0255	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.129	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0103	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.0628	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0621	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.0501	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.0689	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.0724	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.0645	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0361	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0471	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0344	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	Metals	Lead	14.1	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	Metals	Arsenic	4.2	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.15	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	Metals	Zinc	83.1	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	Metals	Cadmium	0.15	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.0078	<
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0073	<
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0036	<
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0051	<
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0067	<
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0039	<

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs) Upper	Lower	Analyte Group	Analyte	Result (mg/kg)	Qualifier
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0046	<
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0021	<
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.0078	<
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	Metals	Copper	50.7	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.6062	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.6873	
D: bare ground	RB-15a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0064	<
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.133	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0502	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0762	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0945	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.106	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.109	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.12	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0443	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0127	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.243	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.081	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.0844	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0463	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0984	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.313	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.339	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.105	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	Metals	Lead	53.3	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0038	<
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0066	<
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.005	<
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0036	<
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0072	<
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	Metals	Arsenic	7	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	1.4064	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	Metals	Copper	103	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	1.0523	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	Metals	Zinc	129	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.0077	<
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0045	<
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0021	<
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0063	<
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.0077	<
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.449	
D: bare ground	RB-15b	10/6/2011	grab	0	0.5	Metals	Cadmium	0.29	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.0098	J
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0462	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0022	J
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0028	<
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.002	J
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0037	J
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.0069	J
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0057	<
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.0332	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.0351	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.2317	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.0098	J
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.003	<
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.005	<
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0052	<
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0036	<
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0016	<
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.004	<
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.0222	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	Metals	Copper	46.7	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.029	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.0201	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0131	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.0199	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.036	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0043	J
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	Metals	Cadmium	0.22	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	Metals	Lead	15.4	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	Metals	Zinc	114	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.0218	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.0192	
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.006	J
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0037	J
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0015	J
I: Erosion scarp	RB-14a	10/6/2011	grab	0	0.5	Metals	Arsenic	5.4	

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs) Upper	Lower	Analyte Group	Analyte	Result (mg/kg)	Qualifier
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.0711	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.002	J
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.0476	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.5781	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0054	<
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0029	<
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0016	<
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0034	<
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0038	<
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.0805	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.005	<
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.0711	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0048	<
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0027	<
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.0704	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	Metals	Arsenic	5.9	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	Metals	Cadmium	0.21	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	Metals	Copper	62.5	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	Metals	Lead	51.3	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	Metals	Zinc	118	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.1026	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0021	J
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0138	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.061	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0236	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.0061	J
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.0874	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0324	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.0711	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0143	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.1	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0047	J
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.059	
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0027	J
I: Erosion scarp	RB-14b	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0047	J
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.0246	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.0474	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.0495	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0026	<
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.0055	<
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0015	<
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0032	<
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.0055	<
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.0028	<
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0109	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.0445	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0023	J
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0046	<
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.3816	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0036	<
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0028	<
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	Butyltins	Tetrabutyltin Ion	0.0044	<
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	Butyltins	Butyltin Ion	0.012	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	Butyltins	Dibutyltin Ion	0.0073	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	Butyltins	Tributyltin	0.13	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.051	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	Metals	Zinc	116	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	Metals	Lead	23.2	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	Metals	Copper	57.2	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	Metals	Cadmium	0.13	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	Metals	Arsenic	3.7	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0048	<
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0174	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0025	J
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0014	J
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0044	J
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0052	<
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0063	J
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.0375	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.0434	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.0617	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.0295	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.0404	
J: Erosion scarp	RB-11a	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0103	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.01	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	Metals	Lead	42.6	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	Metals	Copper	125	

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs) Upper	Lower	Analyte Group	Analyte	Result (mg/kg)	Qualifier
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	Metals	Cadmium	0.1	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	Metals	Arsenic	4.1	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0087	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.078	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0021	J
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.4953	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0021	J
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.002	J
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.0028	J
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.0202	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.0433	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0482	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.0764	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.0392	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0024	J
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	Butyltins	Tributyltin	0.0032	<
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	Butyltins	Dibutyltin Ion	0.0049	<
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	Butyltins	Butyltin Ion	0.0034	<
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	Butyltins	Tetrabutyltin Ion	0.0042	<
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.0416	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0285	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.0322	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.0547	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.0805	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	Metals	Zinc	107	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0209	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.058	
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0014	<
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0031	<
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0027	<
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0044	<
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.005	<
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0025	<
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0035	<
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0046	<
J: Erosion scarp	RB-11b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.058	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.002	J
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0078	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.0103	J
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.0212	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0016	<
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0043	J
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0066	J
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.0218	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.0353	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.0383	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.004	J
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0022	J
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0014	<
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.0365	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0035	<
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.0441	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0049	<
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.0287	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0159	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.0348	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0021	J
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	Metals	Lead	24.6	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.3146	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0424	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0052	<
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0056	<
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0028	<
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0039	<
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.0103	J
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	Metals	Zinc	127	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.0514	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	Metals	Copper	61.4	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	Metals	Cadmium	0.19	
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.003	<
J: Erosion scarp	RB-12a	10/6/2011	grab	0	0.5	Metals	Arsenic	4	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	Metals	Zinc	65.4	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0027	<
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0288	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.3253	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.005	<
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	Metals	Arsenic	3	

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs)		Analyte Group	Analyte	Result (mg/kg)	Qualifier
				Upper	Lower				
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0035	<
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.0257	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	Metals	Lead	17.1	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	Metals	Copper	42.4	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	Metals	Cadmium	0.082	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0044	<
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.0257	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0032	<
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0015	<
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0025	<
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.0406	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0047	<
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0012	<
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.0334	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.0115	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.0028	<
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0013	<
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0018	J
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.0279	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0103	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.0321	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0186	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.0387	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.0536	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0072	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.0297	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0062	J
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.0404	
J: Erosion scarp	RB-12b	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0021	J
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0012	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0028	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.0012	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0012	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0012	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.0011	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.0013	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.0082	
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.0021	J
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	Metals	Zinc	42.3	
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.0013	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0009	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.0015	J
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	Metals	Arsenic	2.2	
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	Metals	Cadmium	0.089	
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	Metals	Copper	25.8	
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	Metals	Lead	7.4	
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.0016	J
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.0016	J
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	Butyltins	Tributyltin	0.0034	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.0055	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0027	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0045	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0047	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0036	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0026	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0051	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.0028	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.0055	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0032	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	Butyltins	Dibutyltin Ion	0.005	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0013	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	Butyltins	Butyltin Ion	0.0035	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	Butyltins	Tetrabutyltin Ion	0.0043	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0013	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.0014	J
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0015	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0012	<
J: Erosion scarp	RB-13a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0015	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.0908	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0023	J
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.002	J
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0012	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0022	J
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.0111	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.0072	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.01	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0035	<

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs) Upper	Depth Interval (feet bgs) Lower	Analyte Group	Analyte	Result (mg/kg)	Qualifier
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.0132	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.012	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0084	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0047	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.0085	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.0102	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0015	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	Butyltins	Tributyltin	0.0034	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	Butyltins	Dibutyltin Ion	0.005	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	Butyltins	Butyltin Ion	0.0018	J
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0045	J
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	Metals	Copper	567	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0013	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0013	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.0028	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.0042	J
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.0118	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0025	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0051	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	Butyltins	Tetrabutyltin Ion	0.0043	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	Metals	Cadmium	0.1	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	Metals	Arsenic	2	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0045	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	Metals	Lead	12	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	Metals	Zinc	77.2	
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0027	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.0078	J
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0032	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0015	<
J: Erosion scarp	RB-13b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.0078	J
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	Butyltins	Butyltin Ion	0.0034	J
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0051	<
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0026	<
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0085	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0036	<
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	Metals	Arsenic	5.3	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	Metals	Zinc	110	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	Butyltins	Tetrabutyltin Ion	0.0043	<
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0015	<
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0332	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	Metals	Cadmium	0.13	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	Metals	Copper	112	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	Metals	Lead	35	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0047	<
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0045	<
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0027	<
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.0773	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0032	<
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.0773	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.4437	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.0544	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	Butyltins	Dibutyltin Ion	0.0038	J
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0059	J
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.0379	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.0516	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.07	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.0475	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	Butyltins	Tributyltin	0.003	J
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.0415	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0136	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0012	<
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.0521	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0015	J
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0013	J
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.0027	<
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.0159	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.0489	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0262	
L: Erosion scarp	RB-10a	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0016	J
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.409	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	Butyltins	Dibutyltin Ion	0.011	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0931	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0366	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	1.13	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.246	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	1.64	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0049	<

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs)		Analyte Group	Analyte	Result (mg/kg)	Qualifier
				Upper	Lower				
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.667	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0024	<
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	1.02	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	1.14	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.783	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.705	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.183	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.236	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0014	<
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Pyrene	1.46	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	1.06	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	Metals	Arsenic	24.1	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	Metals	Cadmium	0.46	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	Metals	Copper	1640	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	Metals	Lead	439	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.124	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.613	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.155	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0031	<
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.613	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0026	<
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0043	<
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0045	<
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0034	<
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	Metals	Zinc	708	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	Butyltins	Tetrabutyltin Ion	0.0041	<
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	Butyltins	Tributyltin	0.0025	J
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	3.5511	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	Anthracene	1.69	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	Butyltins	Butyltin Ion	0.0068	
L: Erosion scarp	RB-10b	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	9.19	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.108	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.149	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0066	J
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.128	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0127	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.2043	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0045	<
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.0218	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0332	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.0955	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0047	<
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0035	<
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0025	<
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0051	<
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	Metals	Copper	298	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	Metals	Lead	225	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	Metals	Zinc	206	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.175	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0367	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0032	<
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.154	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0015	<
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.154	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.127	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.181	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.118	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0121	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	Metals	Cadmium	0.2	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.111	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0564	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	Metals	Arsenic	7	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	1.1866	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0106	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0149	
M: Erosion scarp	RB-9a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0027	<
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.1635	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	Metals	Arsenic	6.7	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.106	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0102	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0187	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.179	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.154	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0713	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.109	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0458	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.158	

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs) Upper	Lower	Analyte Group	Analyte	Result (mg/kg)	Qualifier
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0061	J
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.15	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0041	J
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0078	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.0125	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.0624	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.146	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0345	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.156	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	Metals	Zinc	187	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.156	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	1.2498	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0015	<
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.142	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	Metals	Lead	78.2	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	Metals	Cadmium	0.16	
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0032	<
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0028	<
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0045	<
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0048	<
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0036	<
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0026	<
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0052	<
M: Erosion scarp	RB-9b	10/6/2011	grab	0	0.5	Metals	Copper	284	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	Metals	Arsenic	24.6	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.3002	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0046	<
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.095	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0484	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.133	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.293	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.339	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.368	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0977	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.194	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0428	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0014	<
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.0264	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0058	J
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0044	<
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.0264	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0035	<
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0025	<
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.005	<
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.411	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.131	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.0079	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.005	J
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0031	J
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.321	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0071	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.358	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0027	<
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	Butyltins	Dibutyltin Ion	0.046	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	Metals	Cadmium	0.41	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	Metals	Copper	112	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	2.5575	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	Metals	Lead	77.6	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	Metals	Zinc	428	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	Butyltins	Tetrabutyltin Ion	0.0043	<
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	Butyltins	Butyltin Ion	0.015	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	Butyltins	Tributyltin	0.24	
N: Erosion scarp	RB-8a	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0031	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.0053	J
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Fluoranthene	0.0232	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Fluorene	0.0015	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	1-Methylnaphthalene	0.0013	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1248	0.0045	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Phenanthrene	0.0078	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.0245	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Naphthalene	0.0028	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.0103	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0013	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.0308	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Benzo(a)pyrene	0.0221	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Benz(a)anthracene	0.0144	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Anthracene	0.0045	J

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs) Upper	Lower	Analyte Group	Analyte	Result (mg/kg)	Qualifier
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Acenaphthylene	0.0038	J
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Acenaphthene	0.0012	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	Butyltins	Tributyltin	0.003	J
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	Butyltins	Dibutyltin Ion	0.0049	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	Butyltins	Butyltin Ion	0.0027	J
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	Butyltins	Tetrabutyltin Ion	0.0042	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.1989	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Chrysene	0.0184	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	Metals	Zinc	98	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1242	0.0047	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	Metals	Arsenic	3.7	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	Metals	Cadmium	0.084	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0161	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.025	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	Metals	Lead	21.4	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PAHs	Pyrene	0.0249	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1254	0.0027	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1260	0.0126	J
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1262	0.0032	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1232	0.0036	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	Metals	Copper	60.1	
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1268	0.0015	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1221	0.0026	<
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Total Aroclors	0.0126	J
N: Erosion scarp	RB-8b	10/6/2011	grab	0	0.5	PCBs_Aroclors	Aroclor 1016	0.0051	<
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1232	0.052	<
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1242	0.052	<
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1248	0.052	<
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1254	0.052	<
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	TPH (HCID)	Oil	100	DET
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1016	0.052	<
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Total Aroclors	0.077	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Acenaphthylene	0.061	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1260	0.077	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Phenanthrene	0.092	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	TPH (HCID)	Diesel	50	<
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	Metals	Copper	92.4	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1221	0.11	<
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	TPH (NWTPH-Dx)	Oil	230	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	Metals	Lead	43.2	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Benzo(g,h,i)perylene	0.49	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	Metals	Zinc	174	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Chrysene	0.26	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.43	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Benzo(b)fluoranthene	0.31	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Benzo(a)pyrene	0.32	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Fluoranthene	0.33	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Pyrene	0.43	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Benz(a)anthracene	0.14	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Benzo(k)fluoranthene	0.24	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Low-Molecular Weight PAHs	0.202	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	High-Molecular Weight PAHs	2.984	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	Metals	Silver	0.09	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	Metals	Antimony	0.4	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	Metals	Cadmium	0.46	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Dibenzofuran	0.0033	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	Metals	Arsenic	3.8	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Fluorene	0.0048	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Anthracene	0.024	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	2-Methylnaphthalene	0.0054	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Naphthalene	0.0097	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	Metals	Nickel	16.9	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	Metals	Chromium	19.9	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	TPH (HCID)	Gasoline	20	<
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Acenaphthene	0.0051	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	PAHs	Dibenz(a,h)anthracene	0.034	
WR-159	RB-2 Composite	9/26/2006	composite	0	0.5	TPH (NWTPH-Dx)	Diesel	28	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.015	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Acenaphthylene	0.019	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Benz(a)anthracene	0.05	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Chrysene	0.095	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.11	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Fluoranthene	0.12	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Benzo(a)pyrene	0.13	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Pyrene	0.17	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.18	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Anthracene	0.0072	

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs)		Analyte Group	Analyte	Result (mg/kg)	Qualifier
				Upper	Lower				
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Phenanthrene	0.022	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.15	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	High-Molecular Weight PAHs	1.105	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Dibenzofuran	0.0026	<
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Fluorene	0.0026	<
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Naphthalene	0.0045	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Acenaphthene	0.0026	<
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0026	<
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0527	
WR-159	RB-2a	9/26/2006	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.085	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Phenanthrene	0.15	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Benz(a)anthracene	0.23	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.38	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Chrysene	0.43	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Fluoranthene	0.5	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.52	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.66	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Anthracene	0.041	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Pyrene	0.69	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.72	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.3252	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Benzo(a)pyrene	0.52	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Naphthalene	0.019	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Acenaphthene	0.011	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	2-Methylnaphthalene	0.011	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Fluorene	0.0092	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Dibenzofuran	0.0066	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	High-Molecular Weight PAHs	4.727	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.077	
WR-159	RB-2b	9/26/2006	grab	0	0.5	PAHs	Acenaphthylene	0.084	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.33	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.16	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.1287	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Chrysene	0.19	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0054	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Fluoranthene	0.23	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.23	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Benzo(a)pyrene	0.23	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.27	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Pyrene	0.35	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Benz(a)anthracene	0.11	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	High-Molecular Weight PAHs	2.136	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Anthracene	0.016	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Phenanthrene	0.058	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Fluorene	0.0028	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Dibenzofuran	0.0034	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Acenaphthene	0.0035	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Naphthalene	0.01	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Acenaphthylene	0.033	
WR-159	RB-2c	9/26/2006	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.036	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	Metals	Lead	57.5	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(a)pyrene	0.043	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1221	0.02	<
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Benz(a)anthracene	0.022	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	Metals	Chromium	22.9	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	Metals	Nickel	24.6	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Chrysene	0.035	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Fluoranthene	0.038	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Phenanthrene	0.016	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1260	0.044	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(b)fluoranthene	0.049	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	TPH (NWTPH-Dx)	Diesel	14	J
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.056	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1254	0.014	P
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Total Aroclors	0.058	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(g,h,i)perylene	0.07	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	Metals	Copper	71.3	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	Metals	Zinc	121	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	TPH (NWTPH-Dx)	Oil	130	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Pyrene	0.052	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Acenaphthene	0.00069	J
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	High-Molecular Weight PAHs	0.394	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0371	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	Metals	Silver	0.07	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	Metals	Cadmium	0.189	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(k)fluoranthene	0.017	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	Metals	Antimony	0.63	

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs)		Analyte Group	Analyte	Result (mg/kg)	Qualifier
				Upper	Lower				
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Dibenz(a,h)anthracene	0.012	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Fluorene	0.00091	J
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Dibenzofuran	0.0011	J
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	2-Methylnaphthalene	0.0027	J
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1262	0.01	<
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1268	0.01	<
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	Metals	Arsenic	2.9	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1248	0.01	<
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1242	0.01	<
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1232	0.01	<
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Naphthalene	0.0082	
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	TPH (NWTPH-Gx)	Gasoline	5.8	<
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Anthracene	0.0045	J
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PAHs	Acenaphthylene	0.0041	J
WR-159a	RB-7 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1016	0.01	<
WR-159a	RB-7a	10/1/2008	grab	0	0.5	Metals	Lead	84.2	
WR-159a	RB-7b	10/1/2008	grab	0	0.5	Metals	Lead	104	
WR-159a	RB-7c	10/1/2008	grab	0	0.5	Metals	Lead	18.5	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	2-Methylnaphthalene	0.0035	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Total Aroclors	0.11	U
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	Metals	Antimony	0.35	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	Metals	Cadmium	0.48	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Acenaphthene	0.0028	<
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Fluorene	0.0028	<
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Dibenzofuran	0.0028	<
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	Metals	Silver	0.14	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	Metals	Zinc	264	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Benzo(b)fluoranthene	0.087	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Benzo(a)pyrene	0.094	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	TPH (HCID)	Oil	100	DET
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	TPH (NWTPH-Dx)	Diesel	100	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1221	0.11	<
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.12	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Chrysene	0.082	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Benzo(g,h,i)perylene	0.15	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	Metals	Copper	96.3	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	TPH (NWTPH-Dx)	Oil	820	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	TPH (HCID)	Diesel	50	DET
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	High-Molecular Weight PAHs	0.889	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0659	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Naphthalene	0.0063	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1254	0.055	<
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Pyrene	0.13	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	Metals	Nickel	20.3	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	Metals	Arsenic	7	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Anthracene	0.0091	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Dibenz(a,h)anthracene	0.011	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Acenaphthylene	0.016	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Fluoranthene	0.1	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	TPH (HCID)	Gasoline	20	<
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Benzo(k)fluoranthene	0.07	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	Metals	Chromium	22	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1242	0.055	<
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1248	0.055	<
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Phenanthrene	0.031	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1232	0.055	<
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1016	0.055	<
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PAHs	Benz(a)anthracene	0.045	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	Metals	Lead	36	
WR-160	RB-3 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1260	0.055	<
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.076	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0716	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.788	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.13	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Pyrene	0.12	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.11	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Fluoranthene	0.093	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Benzo(a)pyrene	0.079	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Dibenzofuran	0.0043	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.061	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Benz(a)anthracene	0.036	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Phenanthrene	0.036	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Acenaphthylene	0.015	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.014	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Anthracene	0.009	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Naphthalene	0.0068	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0048	

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs)		Analyte Group	Analyte	Result (mg/kg)	Qualifier
				Upper	Lower				
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Chrysene	0.069	
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Fluorene	0.0026	<
WR-160	RB-3a	9/26/2006	grab	0	0.5	PAHs	Acenaphthene	0.0026	<
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.069	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.08	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Pyrene	0.083	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.087	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	High-Molecular Weight PAHs	0.615	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Anthracene	0.0055	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Benzo(a)pyrene	0.064	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0348	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Dibenzofuran	0.0028	<
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Chrysene	0.062	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.014	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Acenaphthylene	0.0088	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Naphthalene	0.0035	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Fluorene	0.0028	<
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Acenaphthene	0.0028	<
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0028	<
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Phenanthrene	0.017	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Benz(a)anthracene	0.04	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.057	
WR-160	RB-3b	9/26/2006	grab	0	0.5	PAHs	Fluoranthene	0.059	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.19	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Phenanthrene	0.19	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Pyrene	0.29	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Fluoranthene	0.21	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	High-Molecular Weight PAHs	1.665	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.319	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Acenaphthylene	0.023	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Dibenzofuran	0.0071	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	2-Methylnaphthalene	0.012	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Naphthalene	0.013	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Fluorene	0.015	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Chrysene	0.21	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Acenaphthene	0.017	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Benzo(a)pyrene	0.18	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.035	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Anthracene	0.049	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.11	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Benz(a)anthracene	0.11	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.16	
WR-160	RB-3c	9/26/2006	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.17	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.29	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	Metals	Copper	271	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1232	0.054	<
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	TPH (NWTPH-Dx)	Oil	450	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	Metals	Zinc	835	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1221	0.11	<
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1016	0.054	<
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Benzo(g,h,i)perylene	0.36	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1242	0.054	<
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1248	0.054	<
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1254	0.054	<
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	TPH (HCID)	Diesel	50	DET
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	TPH (HCID)	Oil	100	DET
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	High-Molecular Weight PAHs	1.82	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	Metals	Chromium	29	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Low-Molecular Weight PAHs	0.1039	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Pyrene	0.22	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Anthracene	0.014	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	Metals	Silver	0.19	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	Metals	Antimony	0.93	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	Metals	Cadmium	1.04	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Acenaphthene	0.0027	<
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Fluorene	0.0027	<
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Dibenzofuran	0.0027	<
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	2-Methylnaphthalene	0.004	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Benzo(b)fluoranthene	0.21	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Naphthalene	0.0079	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	Metals	Arsenic	12.2	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	TPH (HCID)	Gasoline	20	<
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	Metals	Lead	85.6	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Benzo(a)pyrene	0.17	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Chrysene	0.16	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Benzo(k)fluoranthene	0.16	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Fluoranthene	0.16	

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs)		Analyte Group	Analyte	Result (mg/kg)	Qualifier
				Upper	Lower				
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Acenaphthylene	0.041	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Total Aroclors	0.072	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Dibenz(a,h)anthracene	0.022	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	TPH (NWTPH-Dx)	Diesel	76	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PCBs_Aroclors	Aroclor 1260	0.072	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Benz(a)anthracene	0.068	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	PAHs	Phenanthrene	0.037	
WR-164	RB-1 Composite	9/26/2006	composite	0	0.5	Metals	Nickel	26.8	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Pyrene	0.22	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Benz(a)anthracene	0.061	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.1057	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.26	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	High-Molecular Weight PAHs	1.432	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Phenanthrene	0.046	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Fluorene	0.0028	<
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Dibenzofuran	0.0029	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Acenaphthene	0.0031	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0056	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Naphthalene	0.011	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Anthracene	0.012	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.021	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Chrysene	0.12	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Acenaphthylene	0.028	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.21	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.11	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.14	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Benzo(a)pyrene	0.14	
WR-164	RB-1a	9/26/2006	grab	0	0.5	PAHs	Fluoranthene	0.15	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Fluoranthene	0.15	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.33	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.0914	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	High-Molecular Weight PAHs	1.789	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.03	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.22	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Benzo(a)pyrene	0.18	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Chrysene	0.16	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.14	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Benz(a)anthracene	0.069	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.27	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Phenanthrene	0.033	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Pyrene	0.24	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Anthracene	0.013	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Naphthalene	0.0074	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	2-Methylnaphthalene	0.004	
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Dibenzofuran	0.0027	<
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Fluorene	0.0027	<
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Acenaphthene	0.0027	<
WR-164	RB-1b	9/26/2006	grab	0	0.5	PAHs	Acenaphthylene	0.034	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Acenaphthylene	0.028	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Fluorene	0.0026	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Low-Molecular Weight PAHs	0.1	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Dibenzofuran	0.0027	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Acenaphthene	0.0029	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	2-Methylnaphthalene	0.0036	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Naphthalene	0.0069	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Anthracene	0.014	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Benzo(g,h,i)perylene	0.26	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	High-Molecular Weight PAHs	1.498	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Pyrene	0.2	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Phenanthrene	0.042	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Benz(a)anthracene	0.063	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Benzo(k)fluoranthene	0.12	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Chrysene	0.14	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Fluoranthene	0.15	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Benzo(a)pyrene	0.15	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Benzo(b)fluoranthene	0.18	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.21	
WR-164	RB-1c	9/26/2006	grab	0	0.5	PAHs	Dibenz(a,h)anthracene	0.025	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Low-Molecular Weight PAHs	0.1302	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	High-Molecular Weight PAHs	0.74	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Phthalates	Bis(2-ethylhexyl) Phthalate	0.36	JD
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(b)fluoranthene	0.1	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	TPH (NWTPH-Dx)	Diesel	41	H
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Metals	Silver	0.05	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Benz(a)anthracene	0.045	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Metals	Zinc	153	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1260	0.068	

APPENDIX B Riverbank and Substation A Surface Soil Results

Swan Island OU2 Upland Facility

Riverbank Area	Sample ID	Sample Date	Sample Type	Depth Interval (feet bgs) Upper	Depth Interval (feet bgs) Lower	Analyte Group	Analyte	Result (mg/kg)	Qualifier
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(a)pyrene	0.07	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Indeno(1,2,3-cd)pyrene	0.077	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Chrysene	0.079	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(g,h,i)perylene	0.081	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Benzo(k)fluoranthene	0.033	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Total Aroclors	0.091	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Metals	Lead	41.3	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Phthalates	Dimethyl Phthalate	0.1	<
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Phthalates	Diethyl Phthalate	0.1	<
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Phthalates	Di-n-octyl Phthalate	0.1	<
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Fluoranthene	0.12	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Pyrene	0.12	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Phthalates	Butyl Benzyl Phthalate	0.12	D
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Butyltins	Tributyltin	0.13	D
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Phthalates	Di-n-butyl Phthalate	0.2	<
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	TPH (NWTPH-Dx)	Oil	380	O
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Phenanthrene	0.087	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Naphthalene	0.0092	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Metals	Cadmium	0.238	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Metals	Antimony	0.35	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Acenaphthylene	0.0018	J
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Metals	Arsenic	3.4	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	TPH (NWTPH-Gx)	Gasoline	5.5	<
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	2-Methylnaphthalene	0.0064	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Metals	Copper	65.9	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Acenaphthene	0.0089	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1254	0.023	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Anthracene	0.0093	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Metals	Nickel	15	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Fluorene	0.0076	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Dibenz(a,h)anthracene	0.015	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PAHs	Dibenzofuran	0.01	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	Metals	Chromium	13.6	
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1268	0.01	<
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1262	0.01	<
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1248	0.01	<
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1242	0.01	<
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1232	0.01	<
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1016	0.01	<
WR-399	RB-4 Composite	10/1/2008	composite	0	0.5	PCBs_Aroclors	Aroclor 1221	0.02	<
WR-399	RB-4a	10/1/2008	grab	0	0.5	Metals	Lead	27.2	
WR-399	RB-4a	10/1/2008	grab	0	0.5	Butyltins	Tributyltin	0.067	
WR-399	RB-4b	10/1/2008	grab	0	0.5	Metals	Lead	170	
WR-399	RB-4b	10/1/2008	grab	0	0.5	Butyltins	Tributyltin	0.58	D
WR-399	RB-4c	10/1/2008	grab	0	0.5	Butyltins	Tributyltin	0.005	<
WR-399	RB-4c	10/1/2008	grab	0	0.5	Metals	Lead	91.4	
Historical Substation	Sub A - 2011 - (Comp B)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1221	0.0029	<
Historical Substation	Sub A - 2011 - (Comp B)	2/16/2011	composite	0	1	PCBs_Aroclors	Total Aroclors	0.0062	<
Historical Substation	Sub A - 2011 - (Comp B)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1268	0.0017	<
Historical Substation	Sub A - 2011 - (Comp B)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1262	0.0036	<
Historical Substation	Sub A - 2011 - (Comp B)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1260	0.0062	<
Historical Substation	Sub A - 2011 - (Comp B)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1254	0.0031	<
Historical Substation	Sub A - 2011 - (Comp B)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1248	0.0051	<
Historical Substation	Sub A - 2011 - (Comp B)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1232	0.004	<
Historical Substation	Sub A - 2011 - (Comp B)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1016	0.0058	<
Historical Substation	Sub A - 2011 - (Comp B)	2/16/2011	composite	0	1	TPH (NWTPH-Dx)	Residual-Range	25.4	<
Historical Substation	Sub A - 2011 - (Comp B)	2/16/2011	composite	0	1	TPH (NWTPH-Dx)	Diesel-Range	3.8	<
Historical Substation	Sub A - 2011 - (Comp B)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1242	0.0053	<
Historical Substation	Sub A - 2011 (Comp A)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1260	0.0248	
Historical Substation	Sub A - 2011 (Comp A)	2/16/2011	composite	0	1	TPH (NWTPH-Dx)	Diesel-Range	5.2	J
Historical Substation	Sub A - 2011 (Comp A)	2/16/2011	composite	0	1	PCBs_Aroclors	Total Aroclors	0.0248	
Historical Substation	Sub A - 2011 (Comp A)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1268	0.0016	<
Historical Substation	Sub A - 2011 (Comp A)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1262	0.0035	<
Historical Substation	Sub A - 2011 (Comp A)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1254	0.0029	<
Historical Substation	Sub A - 2011 (Comp A)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1242	0.0051	<
Historical Substation	Sub A - 2011 (Comp A)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1232	0.0038	<
Historical Substation	Sub A - 2011 (Comp A)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1221	0.0028	<
Historical Substation	Sub A - 2011 (Comp A)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1016	0.0055	<
Historical Substation	Sub A - 2011 (Comp A)	2/16/2011	composite	0	1	TPH (NWTPH-Dx)	Residual-Range	31.5	J
Historical Substation	Sub A - 2011 (Comp A)	2/16/2011	composite	0	1	PCBs_Aroclors	Aroclor 1248	0.0049	<

Notes:

ft bgs - feet below ground surface

mg/kg - milligram per kilogram

APPENDIX C
Riverbank Area Surface Soil Summary and Risk Screening - All Receptors

APPENDIX C-1 Riverbank Soil Summary and Risk Screening

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Plants)

Constituents of Interest (COI)				Date		Depth Range (ft)		Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background?	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk?	Max COI Conc. Exceeds SLV - Individual COI Risk?	Risk Ratio for Multiple COIs	Max COI Conc. Exceeds SLV - Multiple COI Risk?	Max COI Conc. Exceeds SLV - Multiple COI Risk?
CASNo	Analyte	Analyte Group/Methods	Units	Min	Max	Min	Max	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)		Plants	Cij	Tij	(Q=1) (T&E)	(Q=5)	Tij/Tj	(Q=1) (T&E)	(Q=5)
78763-54-9	Butyltin Ion	Butyltins	mg/kg	10/6/2011	10/6/2011	0	0.5	8	2	75%	0.0034	0.0035	0.0018	0.015	0.015	NA	NA	NA	0.015	NA	No	No	NA	No	No
14488-53-0	Dibutyltin Ion	Butyltins	mg/kg	10/6/2011	10/6/2011	0	0.5	8	4	50%	0.0049	0.005	0.0038	0.046	0.046	NA	NA	NA	0.046	NA	No	No	NA	No	No
1461-25-2	Tetrabutyltin Ion	Butyltins	mg/kg	10/6/2011	10/6/2011	0	0.5	8	8	0%	0.0041	0.0044			0.0044	NA	NA	NA	<5%D	NA	No	No	NA	No	No
688-73-3	Tributyltin	Butyltins	mg/kg	10/1/2008	10/6/2011	0	0.5	20	7	65%	0.0032	0.005	0.0025	0.58	0.58	NA	NA	NA	0.58	NA	No	No	NA	No	No
7440-36-0	Antimony	Metals	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			0.27	0.93	0.93	4	No	5	0.93	0.186	No	No	0.003	No	No
7440-38-2	Arsenic	Metals	mg/kg	1/1/1998	10/6/2011	0	2	24	0	100%			2	24.6	24.6	7	Yes	18	24.6	1.367	**Yes**	No	0.021	No	No
7440-39-3	Barium	Metals	mg/kg	1/1/1998	1/1/1998	0	2	1	0	100%			81.3	81.3	81.3	NA	NA	500	81.3	0.163	No	No	0.003	No	No
7440-43-9	Cadmium	Metals	mg/kg	1/1/1998	10/6/2011	0	2	24	1	96%	0.5	0.5	0.082	1.11	1.11	1	Yes	32	1.11	0.035	No	No	0.001	No	No
1308-38-9	Chromium	Metals	mg/kg	1/1/1998	10/1/2008	0	2	8	0	100%			12.5	29	29	42	No	1	29	29.0	**Yes**	**Yes**	0.452	**Yes**	**Yes**
7440-50-8	Copper	Metals	mg/kg	9/26/2006	10/6/2011	0	0.5	23	0	100%			25.8	1640	1640	36	Yes	70	1640	23.4	**Yes**	**Yes**	0.365	**Yes**	**Yes**
7439-92-1	Lead	Metals	mg/kg	1/1/1998	10/6/2011	0	2	36	0	100%			6.94	439	439	17	Yes	120	439	3.7	**Yes**	No	0.057	**Yes**	No
7439-97-6	Mercury	Metals	mg/kg	1/1/1998	1/1/1998	0	2	1	1	0%	0.1	0.1			0.1	0.07	Yes	0.3	<5%D	NA	No	No	NA	No	No
7440-02-0	Nickel	Metals	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			15	26.8	26.8	38	No	38	26.8	0.7	No	No	0.011	No	No
7782-49-2	Selenium	Metals	mg/kg	1/1/1998	1/1/1998	0	2	1	1	0%	0.5	0.5			0.5	2	No	0.52	<5%D	NA	No	No	NA	No	No
7440-22-4	Silver	Metals	mg/kg	1/1/1998	10/1/2008	0	2	8	1	88%	0.5	0.5	0.04	0.19	0.5	1	No	560	0.5	0.001	No	No	0.000	No	No
7440-66-6	Zinc	Metals	mg/kg	9/26/2006	10/6/2011	0	0.5	23	0	100%			42.3	835	835	86	Yes	160	835	5.2	**Yes**	**Yes**	0.081	**Yes**	No
132-64-9	Dibenzofuran	PAHs	mg/kg	9/26/2006	10/1/2008	0	0.5	16	5	69%	0.0026	0.0028	0.001	0.01	0.01	NA	NA	NA	0.01	NA	No	No	NA	No	No
90-12-0	1-Methylnaphthalene	PAHs	mg/kg	10/6/2011	10/6/2011	0	0.5	16	5	69%	0.0013	0.0014	0.0014	0.0463	0.0463	NA	NA	NA	0.0463	NA	No	No	NA	No	No
91-57-6	2-Methylnaphthalene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	5	84%	0.0013	0.0028	0.0013	0.0984	0.0984	NA	NA	10	0.0984	0.010	No	No	0.000	No	No
83-32-9	Acenaphthene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	11	66%	0.0012	0.0028	0.0007	0.155	0.155	NA	NA	20	0.155	0.008	No	No	0.000	No	No
208-96-8	Acenaphthylene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.0018	0.183	0.183	NA	NA	10	0.183	0.018	No	No	0.000	No	No
120-12-7	Anthracene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.002	1.69	1.69	NA	NA	10	1.69	0.169	No	No	0.003	No	No
56-55-3	Benz(a)anthracene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0011	0.0011	0.0072	0.705	0.705	NA	NA	NA	0.705	NA	No	No	NA	No	No
50-32-8	Benzo(a)pyrene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0013	0.0013	0.01	0.783	0.783	NA	NA	NA	0.783	NA	No	No	NA	No	No
205-99-2	Benzo(b)fluoranthene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0016	1.14	1.14	NA	NA	NA	1.14	NA	No	No	NA	No	No
191-24-2	Benzo(g,h,i)perylene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0021	1.02	1.02	NA	NA	NA	1.02	NA	No	No	NA	No	No
207-08-9	Benzo(k)fluoranthene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.0045	0.409	0.409	NA	NA	NA	0.409	NA	No	No	NA	No	No
218-01-9	Chrysene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0013	0.0013	0.0085	0.667	0.667	NA	NA	NA	0.667	NA	No	No	NA	No	No
53-70-3	Dibenz(a,h)anthracene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0009	0.0009	0.0023	0.236	0.236	NA	NA	NA	0.236	NA	No	No	NA	No	No
206-44-0	Fluoranthene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0015	1.64	1.64	NA	NA	NA	1.64	NA	No	No	NA	No	No
86-73-7	Fluorene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	10	69%	0.0015	0.0028	0.0007	0.246	0.246	NA	NA	10	0.246	0.025	No	No	0.000	No	No
193-39-5	Indeno(1,2,3-cd)pyrene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0014	1.13	1.13	NA	NA	NA	1.13	NA	No	No	NA	No	No
91-20-3	Naphthalene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	6	81%	0.0027	0.0028	0.0028	0.313	0.313	NA	NA	10	0.313	0.031	No	No	0.0005	No	No
85-01-8	Phenanthrene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.0042	1.06	1.06	NA	NA	10	1.06	0.106	No	No	0.002	No	No
129-00-0	Pyrene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0016	1.46	1.46	NA	NA	NA	1.46	NA	No	No	NA	No	No
LPAH	Low-Molecular Weight PAHs (sum)	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0028	0.0028	0.0084	3.55	3.55	NA	NA	NA	3.55	NA	No	No	NA	No	No
HPAH	High-Molecular Weight PAHs (sum)	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0082	9.19	9.19	NA	NA	NA	9.19	NA	No	No	NA	No	No
12674-11-2	Aroclor 1016	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0049	0.055			0.055	NA	NA	NA	<5%D	NA	No	No	NA	No	No
11104-28-2	Aroclor 1221	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0024	0.11			0.11	NA	NA	NA	<5%D	NA	No	No	NA	No	No
11141-16-5	Aroclor 1232	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0034	0.055			0.055	NA	NA	NA	<5%D	NA	No	No	NA	No	No
53469-21-9	Aroclor 1242	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0045	0.055			0.055	NA	NA	NA	<5%D	NA	No	No	NA	No	No
12672-29-6	Aroclor 1248	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0043	0.055			0.055	NA	NA	NA	<5%D	NA	No	No	NA	No	No
11097-69-1	Aroclor 1254	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	22	8%	0.0026	0.055	0.014	0.023	0.055	NA	NA	NA	0.055	NA	No	No	NA	No	No
11096-82-5	Aroclor 1260	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	6	75%	0.0055	0.055	0.0078	0.613	0.613	NA	NA	NA	0.613	NA	No	No	NA	No	No
37324-23-5	Aroclor 1262	PCBs	mg/kg	10/1/2008	10/6/2011	0	0.5	20	20	0%	0.0031	0.01			0.01	NA	NA	NA	<5%D	NA	No	No	NA	No	No
11100-14-4	Aroclor 1268	PCBs	mg/kg	10/1/2008	10/6/2011	0	0.5	20	20	0%	0.0014	0.01			0.01	NA	NA	NA	<5%D	NA	No	No	NA	No	No
1336-36-3	Total Aroclors	PCBs	mg/kg	9/26/2006	10/6/2011	0	0.5	23	5	78%	0.0055	0.11	0.0078	0.613	0.613	NA	NA	40	0.613	0.015	No	No	0.000	No	No
117-81-7	Bis(2-ethylhexyl) Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	0	100%			0.03	0.36	0.36	NA	NA	NA	0.36	NA	No	No	NA	No	No
85-68-7	Butyl Benzyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	1	67%	0.1	0.1	0.0088	0.12	0.12	NA	NA	NA	0.12	NA	No	No	NA	No	No
84-66-2	Diethyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	2	33%	0.1	0.1	0.0021	0.0021	0.1	NA	NA	100	0.1	0.001	No	No	0.000	No	No
131-11-3	Dimethyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	3	0%	0.01	0.1			0.1	NA	NA	100	<5%D	NA	No	No	NA	No	No
84-74-2	Di-n-butyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	3	0%	0.02	0.2			0.2	NA	NA	200	<5%D	NA	No	No	NA	No	No
117-84-0	Di-n-octyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	3	0%	0.01	0.1			0.1	NA	NA	100	<5%D	NA	No	No	NA	No	No

APPENDIX C-1 Riverbank Soil Summary and Risk Screening

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Plants)

Constituents of Interest (COI)				Date		Depth Range (ft)		Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1] Natural Background Soil Concs (mg/kg)	Max COI Conc. Exceeds Background?	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/Methods	Units	Min	Max	Min	Max	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max				Plants	Cij	Tij			Tij/Tj		
HORHC	Heavy Oil Range Hydrocarbons	TPH (418.1)	mg/kg	1/1/1998	1/1/1998	0	2	1	1	0%	100	100			100	NA	NA	NA	<5%D	NA	No	No	NA	No	No
Diesel	Diesel	TPH (HCID)*	mg/kg	9/26/2006	9/26/2006	0	0.5	3	1	67%	50	50	50	50	50	NA	NA	NA	50	NA	No	No	NA	No	No
Gasoline	Gasoline	TPH (HCID)	mg/kg	9/26/2006	9/26/2006	0	0.5	3	3	0%	20	20			20	NA	NA	NA	<5%D	NA	No	No	NA	No	No
Oil	Oil	TPH (HCID)*	mg/kg	9/26/2006	9/26/2006	0	0.5	3	0	100%			100	100	100	NA	NA	NA	100	NA	No	No	NA	No	No
Diesel	Diesel	TPH (NWTPH-Dx)	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			3.2	100	100	NA	NA	NA	100	NA	No	No	NA	No	No
Oil	Oil	TPH (NWTPH-Dx)	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			27	820	820	NA	NA	NA	820	NA	No	No	NA	No	No
Gasoline	Gasoline	TPH (NWTPH-Gx)	mg/kg	10/1/2008	10/1/2008	0	0.5	4	4	0%	5.5	6.2			6.2	NA	NA	NA	<5%D	NA	No	No	NA	No	No

Tj = Sum of toxicity ratios for all COIs in medium j 64.145

Nij = Number of i COIs in medium j 19.000

1/Nij= 0.053

Notes about data included in summary:

All available data for riverbank locations (both composite and corresponding discrete sub-samples) from 1998 through 2011 are included in summary.

Riverbank locations: Discrete (a, b, c) and composite samples at locations RB-1 through RB-7, PS-S-01-01/Boring 1, Discrete samples (a, b) at RB-8 through RB-15. Samples from Historical Substation A are not included in this screen.

Only data from samples collected within 3 ft included in summary.

* Detected results were identified as "DET"; the Method Reporting Limit (MRL) was used as the detected value (50 mg/kg for diesel; 100 mg/kg for oil)

1 - Refer to Table 3-1 for background and screening level source information.

Acronyms:

DEQ - Oregon Department of Environmental Quality

EPA - U.S. Environmental Protection Agency

ND - non-detect

mg/kg - milligram per kilogram

min - minimum

max - maximum

NA - not available

<5%D - less than 5% detection frequency

COI - constituent of interest

SLV - screening level value

Cij -concentration of COI i in medium j

Tij - toxicity ratios for COI i in medium j

T&E - listed threatened and endangered species

Q = 1 for T&E species

Q = 5 for non-T&E species

APPENDIX C-2 Riverbank Soil Summary and Risk Screening

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Invertebrates)

Constituents of Interest (COI)				Date		Depth Range (ft)		Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background?	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/Methods	Units	Min	Max	Min	Max	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)		Invertebrates	Cij	Tij			Tij/Tj		
78763-54-9	Butyltin Ion	Butyltins	mg/kg	10/6/2011	10/6/2011	0	0.5	8	2	75%	0.0034	0.0035	0.0018	0.015	0.015	NA	NA	NA	0.015	NA	No	No	NA	No	No
14488-53-0	Dibutyltin Ion	Butyltins	mg/kg	10/6/2011	10/6/2011	0	0.5	8	4	50%	0.0049	0.005	0.0038	0.046	0.046	NA	NA	NA	0.046	NA	No	No	NA	No	No
1461-25-2	Tetrabutyltin Ion	Butyltins	mg/kg	10/6/2011	10/6/2011	0	0.5	8	8	0%	0.0041	0.0044			0.0044	NA	NA	NA	<5%D	NA	No	No	NA	No	No
688-73-3	Tributyltin	Butyltins	mg/kg	10/1/2008	10/6/2011	0	0.5	20	7	65%	0.0032	0.005	0.0025	0.58	0.58	NA	NA	NA	0.58	NA	No	No	NA	No	No
7440-36-0	Antimony	Metals	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			0.27	0.93	0.93	4	No	78	0.93	0.01	No	No	0.000	No	No
7440-38-2	Arsenic	Metals	mg/kg	1/1/1998	10/6/2011	0	2	24	0	100%			2	24.6	24.6	7	Yes	60	24.6	0.41	No	No	0.004	No	No
7440-39-3	Barium	Metals	mg/kg	1/1/1998	1/1/1998	0	2	1	0	100%			81.3	81.3	81.3	NA	NA	330	81.3	0.25	No	No	0.002	No	No
7440-43-9	Cadmium	Metals	mg/kg	1/1/1998	10/6/2011	0	2	24	1	96%	0.5	0.5	0.082	1.11	1.11	1	Yes	140	1.11	0.01	No	No	0.000	No	No
1308-38-9	Chromium	Metals	mg/kg	1/1/1998	10/1/2008	0	2	8	0	100%			12.5	29	29	42	No	0.4	29	72.5	**Yes**	**Yes**	0.708	**Yes**	**Yes**
7440-50-8	Copper	Metals	mg/kg	9/26/2006	10/6/2011	0	0.5	23	0	100%			25.8	1640	1640	36	Yes	80	1640	20.5	**Yes**	**Yes**	0.200	**Yes**	No
7439-92-1	Lead	Metals	mg/kg	1/1/1998	10/6/2011	0	2	36	0	100%			6.94	439	439	17	Yes	1700	439	0.258	No	No	0.003	No	No
7439-97-6	Mercury	Metals	mg/kg	1/1/1998	1/1/1998	0	2	1	1	0%	0.1	0.1			0.1	0.07	Yes	0.1	<5%D	NA	No	No	NA	No	No
7440-02-0	Nickel	Metals	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			15	26.8	26.8	38	No	280	26.8	0.10	No	No	0.001	No	No
7782-49-2	Selenium	Metals	mg/kg	1/1/1998	1/1/1998	0	2	1	1	0%	0.5	0.5			0.5	2	No	4.1	<5%D	NA	No	No	NA	No	No
7440-22-4	Silver	Metals	mg/kg	1/1/1998	10/1/2008	0	2	8	1	88%	0.5	0.5	0.04	0.19	0.5	1	No	50	0.5	0.01	No	No	0.000	No	No
7440-66-6	Zinc	Metals	mg/kg	9/26/2006	10/6/2011	0	0.5	23	0	100%			42.3	835	835	86	Yes	120	835	6.96	**Yes**	**Yes**	0.068	**Yes**	No
132-64-9	Dibenzofuran	PAHs	mg/kg	9/26/2006	10/1/2008	0	0.5	16	5	69%	0.0026	0.0028	0.001	0.01	0.01	NA	NA	NA	0.01	NA	No	No	NA	No	No
90-12-0	1-Methylnaphthalene	PAHs	mg/kg	10/6/2011	10/6/2011	0	0.5	16	5	69%	0.0013	0.0014	0.0014	0.0463	0.0463	NA	NA	NA	0.0463	NA	No	No	NA	No	No
91-57-6	2-Methylnaphthalene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	5	84%	0.0013	0.0028	0.0013	0.0984	0.0984	NA	NA	NA	0.0984	NA	No	No	NA	No	No
83-32-9	Acenaphthene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	11	66%	0.0012	0.0028	0.0007	0.155	0.155	NA	NA	NA	0.155	NA	No	No	NA	No	No
208-96-8	Acenaphthylene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.0018	0.183	0.183	NA	NA	NA	0.183	NA	No	No	NA	No	No
120-12-7	Anthracene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.002	1.69	1.69	NA	NA	NA	1.69	NA	No	No	NA	No	No
56-55-3	Benz(a)anthracene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0011	0.0011	0.0072	0.705	0.705	NA	NA	NA	0.705	NA	No	No	NA	No	No
50-32-8	Benzo(a)pyrene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0013	0.0013	0.01	0.783	0.783	NA	NA	NA	0.783	NA	No	No	NA	No	No
205-99-2	Benzo(b)fluoranthene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0016	1.14	1.14	NA	NA	NA	1.14	NA	No	No	NA	No	No
191-24-2	Benzo(g,h,i)perylene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0021	1.02	1.02	NA	NA	NA	1.02	NA	No	No	NA	No	No
207-08-9	Benzo(k)fluoranthene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.0045	0.409	0.409	NA	NA	NA	0.409	NA	No	No	NA	No	No
218-01-9	Chrysene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0013	0.0013	0.0085	0.667	0.667	NA	NA	NA	0.667	NA	No	No	NA	No	No
53-70-3	Dibenz(a,h)anthracene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0009	0.0009	0.0023	0.236	0.236	NA	NA	NA	0.236	NA	No	No	NA	No	No
206-44-0	Fluoranthene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0015	1.64	1.64	NA	NA	NA	1.64	NA	No	No	NA	No	No
86-73-7	Fluorene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	10	69%	0.0015	0.0028	0.0007	0.246	0.246	NA	NA	30	0.246	0.008	No	No	0.000	No	No
193-39-5	Indeno(1,2,3-cd)pyrene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0014	1.13	1.13	NA	NA	NA	1.13	NA	No	No	NA	No	No
91-20-3	Naphthalene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	6	81%	0.0027	0.0028	0.0028	0.313	0.313	NA	NA	NA	0.313	NA	No	No	NA	No	No
85-01-8	Phenanthrene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.0042	1.06	1.06	NA	NA	NA	1.06	NA	No	No	NA	No	No
129-00-0	Pyrene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0016	1.46	1.46	NA	NA	NA	1.46	NA	No	No	NA	No	No
LPAH	Low-Molecular Weight PAHs (sum)	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0028	0.0028	0.0084	3.55	3.55	NA	NA	29	3.55	0.12	No	No	0.001	No	No
HPAH	High-Molecular Weight PAHs (sum)	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0082	9.19	9.19	NA	NA	18	9.19	0.51	No	No	0.005	No	No
12674-11-2	Aroclor 1016	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0049	0.055			0.055	NA	NA	NA	<5%D	NA	No	No	NA	No	No
11104-28-2	Aroclor 1221	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0024	0.11			0.11	NA	NA	NA	<5%D	NA	No	No	NA	No	No
11141-16-5	Aroclor 1232	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0034	0.055			0.055	NA	NA	NA	<5%D	NA	No	No	NA	No	No
53469-21-9	Aroclor 1242	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0045	0.055			0.055	NA	NA	NA	<5%D	NA	No	No	NA	No	No
12672-29-6	Aroclor 1248	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0043	0.055			0.055	NA	NA	NA	<5%D	NA	No	No	NA	No	No
11097-69-1	Aroclor 1254	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	22	8%	0.0026	0.055	0.014	0.023	0.055	NA	NA	NA	0.055	NA	No	No	NA	No	No
11096-82-5	Aroclor 1260	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	6	75%	0.0055	0.055	0.0078	0.613	0.613	NA	NA	NA	0.613	NA	No	No	NA	No	No
37324-23-5	Aroclor 1262	PCBs	mg/kg	10/1/2008	10/6/2011	0	0.5	20	20	0%	0.0031	0.01			0.01	NA	NA	NA	<5%D	NA	No	No	NA	No	No
11100-14-4	Aroclor 1268	PCBs	mg/kg	10/1/2008	10/6/2011	0	0.5	20	20	0%	0.0014	0.01			0.01	NA	NA	NA	<5%D	NA	No	No	NA	No	No
1336-36-3	Total Aroclors	PCBs	mg/kg	9/26/2006	10/6/2011	0	0.5	23	5	78%	0.0055	0.11	0.0078	0.613	0.613	NA	NA	NA	0.613	NA	No	No	NA	No	No
117-81-7	Bis(2-ethylhexyl) Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	0	100%			0.03	0.36	0.36	NA	NA	NA	0.36	NA	No	No	NA	No	No
85-68-7	Butyl Benzyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	1	67%	0.1	0.1	0.0088	0.12	0.12	NA	NA	NA	0.12	NA	No	No	NA	No	No

APPENDIX C-2 Riverbank Soil Summary and Risk Screening

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Invertebrates)

Constituents of Interest (COI)				Date		Depth Range (ft)		Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background?	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/Methods	Units	Min	Max	Min	Max	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)		Invertebrates	Cij	Tij			Tij/Tj		
84-66-2	Diethyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	2	33%	0.1	0.1	0.0021	0.0021	0.1	NA	NA	200	0.1	0.0005	No	No	0.000	No	No
131-11-3	Dimethyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	3	0%	0.01	0.1			0.1	NA	NA	200	<5%D	NA	No	No	NA	No	No
84-74-2	Di-n-butyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	3	0%	0.02	0.2			0.2	NA	NA	NA	<5%D	NA	No	No	NA	No	No
117-84-0	Di-n-octyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	3	0%	0.01	0.1			0.1	NA	NA	NA	<5%D	NA	No	No	NA	No	No
HORHC	Heavy Oil Range Hydrocarbons	TPH (418.1)	mg/kg	1/1/1998	1/1/1998	0	2	1	1	0%	100	100			100	NA	NA	NA	<5%D	NA	No	No	NA	No	No
Diesel	Diesel	TPH (HCID)	mg/kg	9/26/2006	9/26/2006	0	0.5	3	1	67%	50	50	50	50	50	NA	NA	200	50	0.25	No	No	0.002	No	No
Gasoline	Gasoline	TPH (HCID)	mg/kg	9/26/2006	9/26/2006	0	0.5	3	3	0%	20	20			20	NA	NA	100	<5%D	NA	No	No	NA	No	No
Oil	Oil	TPH (HCID)	mg/kg	9/26/2006	9/26/2006	0	0.5	3	0	100%			100	100	100	NA	NA	NA	100	NA	No	No	NA	No	No
Diesel	Diesel	TPH (NWTPH-Dx)	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			3.2	100	100	NA	NA	200	100	0.5	No	No	0.005	No	No
Oil	Oil	TPH (NWTPH-Dx)	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			27	820	820	NA	NA	NA	820	NA	No	No	NA	No	No
Gasoline	Gasoline	TPH (NWTPH-Gx)	mg/kg	10/1/2008	10/1/2008	0	0.5	4	4	0%	5.5	6.2			6.2	NA	NA	100	<5%D	NA	No	No	NA	No	No

Tj = Sum of toxicity ratios for all COIs in medium j 102.390
Nij = Number of i COIs in medium j 16.000
1/Nij= 0.063

Notes about data included in summary:

All available data for riverbank locations (both composite and corresponding discrete sub-samples) from 1998 through 2011 are included in summary.

Riverbank locations: Discrete (a, b, c) and composite samples at locations RB-1 through RB-7, PS-S-01-01/Boring 1, Discrete samples (a, b) at RB-8 through RB-15. Samples from Historical Substation A are not included in this screen.

Only data from samples collected within 3 ft included in summary.

* Detected results were identified as "DET"; the Method Reporting Limit (MRL) was used as the detected value (50 mg/kg for diesel; 100 mg/kg for oil)

1 - Refer to Table 3-1 for background and screening level source information.

Acronyms:

DEQ - Oregon Department of Environmental Quality
EPA - U.S. Environmental Protection Agency
ND - non-detect
mg/kg - milligram per kilogram
min - minimum
max - maximum
NA - not available
<5%D - less than 5% detection frequency
COI - constituent of interest
SLV - screening level value
Cij -concentration of COI i in medium j
Tij - toxicity ratios for COI i in medium j
T&E - listed threatened and endangered species
Q = 1 for T&E species
Q = 5 for non-T&E species

APPENDIX C-3 Riverbank Soil Summary and Risk Screening

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Birds)

Constituents of Interest (COI)				Date		Depth Range (ft)		Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background?	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/Methods	Units	Min	Max	Min	Max	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)		Birds	Cij	Tij			Tij/Tj		
78763-54-9	Butyltin Ion	Butyltins	mg/kg	10/6/2011	10/6/2011	0	0.5	8	2	75%	0.0034	0.0035	0.0018	0.015	0.015	NA	NA	NA	0.015	NA	No	No	NA	No	No
14488-53-0	Dibutyltin Ion	Butyltins	mg/kg	10/6/2011	10/6/2011	0	0.5	8	4	50%	0.0049	0.005	0.0038	0.046	0.046	NA	NA	NA	0.046	NA	No	No	NA	No	No
1461-25-2	Tetrabutyltin Ion	Butyltins	mg/kg	10/6/2011	10/6/2011	0	0.5	8	8	0%	0.0041	0.0044			0.0044	NA	NA	NA	<5%D	NA	No	No	NA	No	No
688-73-3	Tributyltin	Butyltins	mg/kg	10/1/2008	10/6/2011	0	0.5	20	7	65%	0.0032	0.005	0.0025	0.58	0.58	NA	NA	28	0.58	0.02	No	No	0.000	No	No
7440-36-0	Antimony	Metals	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			0.27	0.93	0.93	4	No	NA	0.93	NA	No	No	NA	No	No
7440-38-2	Arsenic	Metals	mg/kg	1/1/1998	10/6/2011	0	2	24	0	100%			2	24.6	24.6	7	Yes	43	24.6	0.6	No	No	0.005	No	No
7440-39-3	Barium	Metals	mg/kg	1/1/1998	1/1/1998	0	2	1	0	100%			81.3	81.3	81.3	NA	NA	85	81.3	1.0	No	No	0.008	No	No
7440-43-9	Cadmium	Metals	mg/kg	1/1/1998	10/6/2011	0	2	24	1	96%	0.5	0.5	0.082	1.11	1.11	1	Yes	0.77	1.11	1.4	**Yes**	No	0.012	No	No
1308-38-9	Chromium	Metals	mg/kg	1/1/1998	10/1/2008	0	2	8	0	100%			12.5	29	29	42	No	26	29	1.1	**Yes**	No	0.009	No	No
7440-50-8	Copper	Metals	mg/kg	9/26/2006	10/6/2011	0	0.5	23	0	100%			25.8	1640	1640	36	Yes	28	1640	58.6	**Yes**	**Yes**	0.476	**Yes**	**Yes**
7439-92-1	Lead	Metals	mg/kg	1/1/1998	10/6/2011	0	2	36	0	100%			6.94	439	439	17	Yes	11	439	39.9	**Yes**	**Yes**	0.324	**Yes**	**Yes**
7439-97-6	Mercury	Metals	mg/kg	1/1/1998	1/1/1998	0	2	1	1	0%	0.1	0.1			0.1	0.07	Yes	1.5	<5%D	NA	No	No	NA	No	No
7440-02-0	Nickel	Metals	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			15	26.8	26.8	38	No	210	26.8	0.1	No	No	0.001	No	No
7782-49-2	Selenium	Metals	mg/kg	1/1/1998	1/1/1998	0	2	1	1	0%	0.5	0.5			0.5	2	No	1.2	<5%D	NA	No	No	NA	No	No
7440-22-4	Silver	Metals	mg/kg	1/1/1998	10/1/2008	0	2	8	1	88%	0.5	0.5	0.04	0.19	0.5	1	No	4.2	0.5	0.1	No	No	0.001	No	No
7440-66-6	Zinc	Metals	mg/kg	9/26/2006	10/6/2011	0	0.5	23	0	100%			42.3	835	835	86	Yes	46	835	18.2	**Yes**	**Yes**	0.148	**Yes**	No
132-64-9	Dibenzofuran	PAHs	mg/kg	9/26/2006	10/1/2008	0	0.5	16	5	69%	0.0026	0.0028	0.001	0.01	0.01	NA	NA	NA	0.01	NA	No	No	NA	No	No
90-12-0	1-Methylnaphthalene	PAHs	mg/kg	10/6/2011	10/6/2011	0	0.5	16	5	69%	0.0013	0.0014	0.0014	0.0463	0.0463	NA	NA	NA	0.0463	NA	No	No	NA	No	No
91-57-6	2-Methylnaphthalene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	5	84%	0.0013	0.0028	0.0013	0.0984	0.0984	NA	NA	NA	0.0984	NA	No	No	NA	No	No
83-32-9	Acenaphthene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	11	66%	0.0012	0.0028	0.0007	0.155	0.155	NA	NA	NA	0.155	NA	No	No	NA	No	No
208-96-8	Acenaphthylene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.0018	0.183	0.183	NA	NA	NA	0.183	NA	No	No	NA	No	No
120-12-7	Anthracene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.002	1.69	1.69	NA	NA	NA	1.69	NA	No	No	NA	No	No
56-55-3	Benz(a)anthracene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0011	0.0011	0.0072	0.705	0.705	NA	NA	NA	0.705	NA	No	No	NA	No	No
50-32-8	Benzo(a)pyrene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0013	0.0013	0.01	0.783	0.783	NA	NA	NA	0.783	NA	No	No	NA	No	No
205-99-2	Benzo(b)fluoranthene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0016	1.14	1.14	NA	NA	NA	1.14	NA	No	No	NA	No	No
191-24-2	Benzo(g,h,i)perylene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0021	1.02	1.02	NA	NA	NA	1.02	NA	No	No	NA	No	No
207-08-9	Benzo(k)fluoranthene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.0045	0.409	0.409	NA	NA	NA	0.409	NA	No	No	NA	No	No
218-01-9	Chrysene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0013	0.0013	0.0085	0.667	0.667	NA	NA	NA	0.667	NA	No	No	NA	No	No
53-70-3	Dibenz(a,h)anthracene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0009	0.0009	0.0023	0.236	0.236	NA	NA	NA	0.236	NA	No	No	NA	No	No
206-44-0	Fluoranthene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0015	1.64	1.64	NA	NA	NA	1.64	NA	No	No	NA	No	No
86-73-7	Fluorene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	10	69%	0.0015	0.0028	0.0007	0.246	0.246	NA	NA	NA	0.246	NA	No	No	NA	No	No
193-39-5	Indeno(1,2,3-cd)pyrene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0014	1.13	1.13	NA	NA	NA	1.13	NA	No	No	NA	No	No
91-20-3	Naphthalene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	6	81%	0.0027	0.0028	0.0028	0.313	0.313	NA	NA	NA	0.313	NA	No	No	NA	No	No
85-01-8	Phenanthrene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.0042	1.06	1.06	NA	NA	NA	1.06	NA	No	No	NA	No	No
129-00-0	Pyrene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0016	1.46	1.46	NA	NA	NA	1.46	NA	No	No	NA	No	No
LPAH	Low-Molecular Weight PAHs (sum)	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0028	0.0028	0.0084	3.55	3.55	NA	NA	NA	3.55	NA	No	No	NA	No	No
HPAH	High-Molecular Weight PAHs (sum)	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0082	9.19	9.19	NA	NA	NA	9.19	NA	No	No	NA	No	No
12674-11-2	Aroclor 1016	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0049	0.055			0.055	NA	NA	0.7	<5%D	NA	No	No	NA	No	No
11104-28-2	Aroclor 1221	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0024	0.11			0.11	NA	NA	0.7	<5%D	NA	No	No	NA	No	No
11141-16-5	Aroclor 1232	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0034	0.055			0.055	NA	NA	0.7	<5%D	NA	No	No	NA	No	No
53469-21-9	Aroclor 1242	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0045	0.055			0.055	NA	NA	1.5	<5%D	NA	No	No	NA	No	No
12672-29-6	Aroclor 1248	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0043	0.055			0.055	NA	NA	0.7	<5%D	NA	No	No	NA	No	No
11097-69-1	Aroclor 1254	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	22	8%	0.0026	0.055	0.014	0.023	0.055	NA	NA	0.7	0.055	0.079	No	No	0.001	No	No
11096-82-5	Aroclor 1260	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	6	75%	0.0055	0.055	0.0078	0.613	0.613	NA	NA	0.7	0.613	0.876	No	No	0.007	No	No
37324-23-5	Aroclor 1262	PCBs	mg/kg	10/1/2008	10/6/2011	0	0.5	20	20	0%	0.0031	0.01			0.01	NA	NA	0.7	<5%D	NA	No	No	NA	No	No
11100-14-4	Aroclor 1268	PCBs	mg/kg	10/1/2008	10/6/2011	0	0.5	20	20	0%	0.0014	0.01			0.01	NA	NA	0.7	<5%D	NA	No	No	NA	No	No
1336-36-3	Total Aroclors	PCBs	mg/kg	9/26/2006	10/6/2011	0	0.5	23	5	78%	0.0055	0.11	0.0078	0.613	0.613	NA	NA	0.65	0.613	0.943	No	No	0.008	No	No
117-81-7	Bis(2-ethylhexyl) Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	0	100%			0.03	0.36	0.36	NA	NA	4.5	0.36	0.08	No	No	0.001	No	No
85-68-7	Butyl Benzyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	1	67%	0.1	0.1	0.0088	0.12	0.12	NA	NA	NA	0.12	NA	No	No	NA	No	No

APPENDIX C-3 Riverbank Soil Summary and Risk Screening

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Birds)

Constituents of Interest (COI)				Date		Depth Range (ft)		Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background?	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/Methods	Units	Min	Max	Min	Max	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)		Birds	Cij	Tij			Tij/Tj		
84-66-2	Diethyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	2	33%	0.1	0.1	0.0021	0.0021	0.1	NA	NA	NA	0.1	NA	No	No	NA	No	No
131-11-3	Dimethyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	3	0%	0.01	0.1			0.1	NA	NA	NA	<5%D	NA	No	No	NA	No	No
84-74-2	Di-n-butyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	3	0%	0.02	0.2			0.2	NA	NA	0.45	<5%D	NA	No	No	NA	No	No
117-84-0	Di-n-octyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	3	0%	0.01	0.1			0.1	NA	NA	0.45	<5%D	NA	No	No	NA	No	No
HORHC	Heavy Oil Range Hydrocarbons	TPH (418.1)	mg/kg	1/1/1998	1/1/1998	0	2	1	1	0%	100	100			100	NA	NA	NA	<5%D	NA	No	No	NA	No	No
Diesel	Diesel	TPH (HCID)	mg/kg	9/26/2006	9/26/2006	0	0.5	3	1	67%	50	50	50	50	50	NA	NA	6000	50	0.0083333	No	No	0.000	No	No
Gasoline	Gasoline	TPH (HCID)	mg/kg	9/26/2006	9/26/2006	0	0.5	3	3	0%	20	20			20	NA	NA	5000	<5%D	NA	No	No	NA	No	No
Oil	Oil	TPH (HCID)	mg/kg	9/26/2006	9/26/2006	0	0.5	3	0	100%			100	100	100	NA	NA	NA	100	NA	No	No	NA	No	No
Diesel	Diesel	TPH (NWTPH-Dx)	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			3.2	100	100	NA	NA	6000	100	0.02	No	No	0.0001	No	No
Oil	Oil	TPH (NWTPH-Dx)	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			27	820	820	NA	NA	NA	820	NA	No	No	NA	No	No
Gasoline	Gasoline	TPH (NWTPH-Gx)	mg/kg	10/1/2008	10/1/2008	0	0.5	4	4	0%	5.5	6.2			6.2	NA	NA	5000	<5%D	NA	No	No	NA	No	No

Tj = Sum of toxicity ratios for all COIs in medium j 122.988

Nij = Number of i COIs in medium j 16.000

1/Nij= 0.063

Notes about data included in summary:

All available data for riverbank locations (both composite and corresponding discrete sub-samples) from 1998 through 2011 are included in summary.

Riverbank locations: Discrete (a, b, c) and composite samples at locations RB-1 through RB-7, PS-S-01-01/Boring 1, Discrete samples (a, b) at RB-8 through RB-15. Samples from Historical Substation A are not included in this screen.

Only data from samples collected within 3 ft included in summary.

* Detected results were identified as "DET"; the Method Reporting Limit (MRL) was used as the detected value (50 mg/kg for diesel; 100 mg/kg for oil)

1 - Refer to Table 3-1 for background and screening level source information.

Acronyms:

- DEQ - Oregon Department of Environmental Quality
- EPA - U.S. Environmental Protection Agency
- ND - non-detect
- mg/kg - milligram per kilogram
- min - minimum
- max - maximum
- NA - not available
- <5%D - less than 5% detection frequency
- COI - constituent of interest
- SLV - screening level value
- Cij -concentration of COI i in medium j
- Tij - toxicity ratios for COI i in medium j
- T&E - listed threatened and endangered species
- Q = 1 for T&E species
- Q = 5 for non-T&E species

APPENDIX C-4 Riverbank Soil Summary and Risk Screening

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Mammals)

Constituents of Interest (COI)				Date		Depth Range (ft)		Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background?	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/Methods	Units	Min	Max	Min	Max	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)		Mammals	Cij	Tij			Tij/Tj		
78763-54-9	Butyltin Ion	Butyltins	mg/kg	10/6/2011	10/6/2011	0	0.5	8	2	75%	0.0034	0.0035	0.0018	0.015	0.015	NA	NA	NA	0.015	NA	No	No	NA	No	No
14488-53-0	Dibutyltin Ion	Butyltins	mg/kg	10/6/2011	10/6/2011	0	0.5	8	4	50%	0.0049	0.005	0.0038	0.046	0.046	NA	NA	NA	0.046	NA	No	No	NA	No	No
1461-25-2	Tetrabutyltin Ion	Butyltins	mg/kg	10/6/2011	10/6/2011	0	0.5	8	8	0%	0.0041	0.0044			0.0044	NA	NA	NA	<5%D	NA	No	No	NA	No	No
688-73-3	Tributyltin	Butyltins	mg/kg	10/1/2008	10/6/2011	0	0.5	20	7	65%	0.0032	0.005	0.0025	0.58	0.58	NA	NA	1300	0.58	0.00	No	No	0.00001	No	No
7440-36-0	Antimony	Metals	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			0.27	0.93	0.93	4	No	0.27	0.93	3.44	**Yes**	No	0.045	**Yes**	No
7440-38-2	Arsenic	Metals	mg/kg	1/1/1998	10/6/2011	0	2	24	0	100%			2	24.6	24.6	7	Yes	46	24.6	0.53	No	No	0.007	No	No
7440-39-3	Barium	Metals	mg/kg	1/1/1998	1/1/1998	0	2	1	0	100%			81.3	81.3	81.3	NA	NA	2000	81.3	0.04	No	No	0.001	No	No
7440-43-9	Cadmium	Metals	mg/kg	1/1/1998	10/6/2011	0	2	24	1	96%	0.5	0.5	0.082	1.11	1.11	1	Yes	0.36	1.11	3.08	**Yes**	No	0.040	**Yes**	No
1308-38-9	Chromium	Metals	mg/kg	1/1/1998	10/1/2008	0	2	8	0	100%			12.5	29	29	42	No	34	29	0.85	No	No	0.011	No	No
7440-50-8	Copper	Metals	mg/kg	9/26/2006	10/6/2011	0	0.5	23	0	100%			25.8	1640	1640	36	Yes	49	1640	33.47	**Yes**	**Yes**	0.439	**Yes**	**Yes**
7439-92-1	Lead	Metals	mg/kg	1/1/1998	10/6/2011	0	2	36	0	100%			6.94	439	439	17	Yes	56	439	7.84	**Yes**	**Yes**	0.103	**Yes**	No
7439-97-6	Mercury	Metals	mg/kg	1/1/1998	1/1/1998	0	2	1	1	0%	0.1	0.1			0.1	0.07	Yes	73	<5%D	NA	No	No	NA	No	No
7440-02-0	Nickel	Metals	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			15	26.8	26.8	38	No	130	26.8	0.21	No	No	0.003	No	No
7782-49-2	Selenium	Metals	mg/kg	1/1/1998	1/1/1998	0	2	1	1	0%	0.5	0.5			0.5	2	No	0.63	<5%D	NA	No	No	NA	No	No
7440-22-4	Silver	Metals	mg/kg	1/1/1998	10/1/2008	0	2	8	1	88%	0.5	0.5	0.04	0.19	0.5	1	No	14	0.5	0.04	No	No	0.0005	No	No
7440-66-6	Zinc	Metals	mg/kg	9/26/2006	10/6/2011	0	0.5	23	0	100%			42.3	835	835	86	Yes	79	835	10.57	**Yes**	**Yes**	0.139	**Yes**	**Yes**
132-64-9	Dibenzofuran	PAHs	mg/kg	9/26/2006	10/1/2008	0	0.5	16	5	69%	0.0026	0.0028	0.001	0.01	0.01	NA	NA	0.002	0.01	5	**Yes**	No	0.066	**Yes**	No
90-12-0	1-Methylnaphthalene	PAHs	mg/kg	10/6/2011	10/6/2011	0	0.5	16	5	69%	0.0013	0.0014	0.0014	0.0463	0.0463	NA	NA	NA	0.0463	NA	No	No	NA	No	No
91-57-6	2-Methylnaphthalene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	5	84%	0.0013	0.0028	0.0013	0.0984	0.0984	NA	NA	3900	0.0984	2.52E-05	No	No	3.30761E-07	No	No
83-32-9	Acenaphthene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	11	66%	0.0012	0.0028	0.0007	0.155	0.155	NA	NA	3900	0.155	3.97E-05	No	No	5.21016E-07	No	No
208-96-8	Acenaphthylene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.0018	0.183	0.183	NA	NA	3900	0.183	4.69E-05	No	No	6.15135E-07	No	No
120-12-7	Anthracene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.002	1.69	1.69	NA	NA	3900	1.69	0.000433	No	No	5.68076E-06	No	No
56-55-3	Benz(a)anthracene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0011	0.0011	0.0072	0.705	0.705	NA	NA	125	0.705	0.006	No	No	0.0001	No	No
50-32-8	Benzo(a)pyrene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0013	0.0013	0.01	0.783	0.783	NA	NA	125	0.783	0.006	No	No	0.0001	No	No
205-99-2	Benzo(b)fluoranthene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0016	1.14	1.14	NA	NA	125	1.14	0.009	No	No	0.0001	No	No
191-24-2	Benzo(g,h,i)perylene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0021	1.02	1.02	NA	NA	125	1.02	0.008	No	No	0.0001	No	No
207-08-9	Benzo(k)fluoranthene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.0045	0.409	0.409	NA	NA	125	0.409	0.003	No	No	0.00004	No	No
218-01-9	Chrysene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0013	0.0013	0.0085	0.667	0.667	NA	NA	125	0.667	0.005336	No	No	6.9952E-05	No	No
53-70-3	Dibenz(a,h)anthracene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0009	0.0009	0.0023	0.236	0.236	NA	NA	125	0.236	0.001888	No	No	2.47506E-05	No	No
206-44-0	Fluoranthene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0015	1.64	1.64	NA	NA	125	1.64	0.01312	No	No	0.000171996	No	No
86-73-7	Fluorene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	10	69%	0.0015	0.0028	0.0007	0.246	0.246	NA	NA	3900	0.246	6.31E-05	No	No	8.26903E-07	No	No
193-39-5	Indeno(1,2,3-cd)pyrene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0014	1.13	1.13	NA	NA	125	1.13	0.00904	No	No	0.000118509	No	No
91-20-3	Naphthalene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	6	81%	0.0027	0.0028	0.0028	0.313	0.313	NA	NA	3900	0.313	0.0001	No	No	0.000001	No	No
85-01-8	Phenanthrene	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0012	0.0012	0.0042	1.06	1.06	NA	NA	3900	1.06	0.000272	No	No	3.56308E-06	No	No
129-00-0	Pyrene	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0016	1.46	1.46	NA	NA	125	1.46	0.01168	No	No	0.000153118	No	No
LPAH	Low-Molecular Weight PAHs (sum)	LPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	1	97%	0.0028	0.0028	0.0084	3.55	3.55	NA	NA	100	3.55	0.04	No	No	0.0005	No	No
HPAH	High-Molecular Weight PAHs (sum)	HPAHs	mg/kg	9/26/2006	10/6/2011	0	0.5	32	0	100%			0.0082	9.19	9.19	NA	NA	1.1	9.19	8.35	**Yes**	**Yes**	0.11	**Yes**	No
12674-11-2	Aroclor 1016	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0049	0.055			0.055	NA	NA	100	<5%D	NA	No	No	NA	No	No
11104-28-2	Aroclor 1221	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0024	0.11			0.11	NA	NA	4	<5%D	NA	No	No	NA	No	No
11141-16-5	Aroclor 1232	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0034	0.055			0.055	NA	NA	4	<5%D	NA	No	No	NA	No	No
53469-21-9	Aroclor 1242	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0045	0.055			0.055	NA	NA	5	<5%D	NA	No	No	NA	No	No
12672-29-6	Aroclor 1248	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	24	0%	0.0043	0.055			0.055	NA	NA	4	<5%D	NA	No	No	NA	No	No
11097-69-1	Aroclor 1254	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	22	8%	0.0026	0.055	0.014	0.023	0.055	NA	NA	4	0.055	0.014	No	No	0.0002	No	No
11096-82-5	Aroclor 1260	PCBs	mg/kg	1/1/1998	10/6/2011	0	2	24	6	75%	0.0055	0.055	0.0078	0.613	0.613	NA	NA	4	0.613	0.153	No	No	0.0020	No	No
37324-23-5	Aroclor 1262	PCBs	mg/kg	10/1/2008	10/6/2011	0	0.5	20	20	0%	0.0031	0.01			0.01	NA	NA	4	<5%D	NA	No	No	NA	No	No
11100-14-4	Aroclor 1268	PCBs	mg/kg	10/1/2008	10/6/2011	0	0.5	20	20	0%	0.0014	0.01			0.01	NA	NA	4	<5%D	NA	No	No	NA	No	No
1336-36-3	Total Aroclors	PCBs	mg/kg	9/26/2006	10/6/2011	0	0.5	23	5	78%	0.0055	0.11	0.0078	0.613	0.613	NA	NA	0.371	0.613	1.652	**Yes**	No	0.0217	No	No
117-81-7	Bis(2-ethylhexyl) Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	0	100%			0.03	0.36	0.36	NA	NA	0.925	0.36	0.3892	No	No	0.005102	No	No
85-68-7	Butyl Benzyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	1	67%	0.1	0.1	0.0088	0.12	0.12	NA	NA	0.239	0.12	0.502092	No	No	0.006582147	No	No

APPENDIX C-4 Riverbank Soil Summary and Risk Screening

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Mammals)

Constituents of Interest (COI)				Date		Depth Range (ft)		Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background?	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/Methods	Units	Min	Max	Min	Max	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)		Mammals	Cij	Tij			Tij/Tj		
84-66-2	Diethyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	2	33%	0.1	0.1	0.0021	0.0021	0.1	NA	NA	24.8	0.1	0.004032	No	No	0.000052861	No	No
131-11-3	Dimethyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	3	0%	0.01	0.1			0.1	NA	NA	734	<5%D	NA	No	No	NA	No	No
84-74-2	Di-n-butyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	3	0%	0.02	0.2			0.2	NA	NA	0.15	<5%D	NA	***ND>SLV***	***ND>SLV***	NA	No	No
117-84-0	Di-n-octyl Phthalate	Phthalates	mg/kg	10/1/2008	10/1/2008	0	0.5	3	3	0%	0.01	0.1			0.1	NA	NA	709	<5%D	NA	No	No	NA	No	No
HORHC	Heavy Oil Range Hydrocarbons	TPH (418.1)	mg/kg	1/1/1998	1/1/1998	0	2	1	1	0%	100	100			100	NA	NA	NA	<5%D	NA	No	No	NA	No	No
Diesel	Diesel	TPH (HCID)	mg/kg	9/26/2006	9/26/2006	0	0.5	3	1	67%	50	50	50	50	50	NA	NA	6000	50	0.008333	No	No	0.000109245	No	No
Gasoline	Gasoline	TPH (HCID)	mg/kg	9/26/2006	9/26/2006	0	0.5	3	3	0%	20	20			20	NA	NA	5000	<5%D	NA	No	No	NA	No	No
Oil	Oil	TPH (HCID)	mg/kg	9/26/2006	9/26/2006	0	0.5	3	0	100%			100	100	100	NA	NA	NA	100	NA	No	No	NA	No	No
Diesel	Diesel	TPH (NWTPH-Dx)	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			3.2	100	100	NA	NA	6000	100	0.02	No	No	0.0002	No	No
Oil	Oil	TPH (NWTPH-Dx)	mg/kg	9/26/2006	10/1/2008	0	0.5	7	0	100%			27	820	820	NA	NA	NA	820	NA	No	No	NA	No	No
Gasoline	Gasoline	TPH (NWTPH-Gx)	mg/kg	10/1/2008	10/1/2008	0	0.5	4	4	0%	5.5	6.2			6.2	NA	NA	5000	<5%D	NA	No	No	NA	No	No

Tj = Sum of toxicity ratios for all COIs in medium j 76.281

Nij = Number of i COIs in medium j 39.000

1/Nij= 0.026

Notes about data included in summary:

All available data for riverbank locations (both composite and corresponding discrete sub-samples) from 1998 through 2011 are included in summary.

Riverbank locations: Discrete (a, b, c) and composite samples at locations RB-1 through RB-7, PS-S-01-01/Boring 1, Discrete samples (a, b) at RB-8 through RB-15. Samples from Historical Substation A are not included in this screen.

Only data from samples collected within 3 ft included in summary.

* Detected results were identified as "DET"; the Method Reporting Limit (MRL) was used as the detected value (50 mg/kg for diesel; 100 mg/kg for oil)

1 - Refer to Table 3-1 for background and screening level source information.

Acronyms:

DEQ - Oregon Department of Environmental Quality
EPA - U.S. Environmental Protection Agency
ND - non-detect
mg/kg - milligram per kilogram
min - minimum
max - maximum
NA - not available
<5%D - less than 5% detection frequency
COI - constituent of interest
SLV - screening level value
Cij -concentration of COI i in medium j
Tij - toxicity ratios for COI i in medium j
T&E - listed threatened and endangered species
Q = 1 for T&E species
Q = 5 for non-T&E species

APPENDIX D
Riverbank Area Surface Soil Summary with 90UCLs and Risk Screening – Wildlife Receptors

APPENDIX D-1 Riverbank Soil Summary with 90UCLs and Risk Screening - Wildlife Receptors

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Birds)

Constituents of Interest (COI)			Depth Range (ft)		Number of Samples	Detected Concentrations		Overall Max	Background Levels[1]	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	COI Concentration (90UCL) - based on information from Composite Samples				Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV-Individual COI Risk? (Q=5)	COI Concentration (90UCL) - based on information from Discrete Samples				Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV-Individual COI Risk? (Q=5)
CASNo	Analyte	Units	Min	Max		Min	Max		Natural Background Soil Concs (mg/kg)		n	Cij	Dist.	Estimation Method	Tij			n	Cij	Dist.	Estimation Method	Tij		
7440-50-8	Copper	mg/kg	0	0.5	23	25.8	1640	1640	36	28	7	171	Gamma	90% Adjusted Gamma UCL	6.1	**Yes**	**Yes**	16	529.4	Lognormal	90% Chebyshev (Mean, Sd) UCL	18.9	**Yes**	**Yes**
7439-92-1	Lead	mg/kg	0	2	36	6.94	439	439	17	11	7	57.74	Normal	90% Student's-t UCL	5.2	**Yes**	**Yes**	29	85.44	Gamma	90% Adjusted Gamma UCL	7.8	**Yes**	**Yes**
7440-66-6	Zinc	mg/kg	0	0.5	23	42.3	835	835	86	46	7	536.9	Gamma	90% Adjusted Gamma UCL	11.7	**Yes**	**Yes**	16	296.1	Lognormal	90% Chebyshev (Mean, Sd) UCL	6.4	**Yes**	**Yes**

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Mammals)

Constituents of Interest (COI)			Depth Range (ft)		Number of Samples	Detected Concentrations		Overall Max	Background Levels[1]	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	COI Concentration (90UCL) - based on information from Composite Samples				Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV-Individual COI Risk? (Q=5)	COI Concentration (90UCL) - based on information from Discrete Samples				Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV-Individual COI Risk? (Q=5)
CASNo	Analyte	Units	Min	Max		Min	Max		Natural Background Soil Concs (mg/kg)		n	Cij	Dist.	Estimation Method	Tij			n	Cij	Dist.	Estimation Method	Tij		
7440-50-8	Copper	mg/kg	0	0.5	23	25.8	1640	1640	36	49	7	171	Gamma	90% Adjusted Gamma UCL	3.5	**Yes**	No	16	529.4	Lognormal	90% Chebyshev (Mean, Sd) UCL	10.8	**Yes**	**Yes**
7439-92-1	Lead	mg/kg	0	2	36	6.94	439	439	17	56	7	57.74	Normal	90% Student's-t UCL	1.0	**Yes**	No	29	85.44	Gamma	90% Adjusted Gamma UCL	1.5	**Yes**	No
7440-66-6	Zinc	mg/kg	0	0.5	23	42.3	835	835	86	79	7	536.9	Gamma	90% Adjusted Gamma UCL	6.8	**Yes**	**Yes**	16	296.1	Lognormal	90% Chebyshev (Mean, Sd) UCL	3.7	**Yes**	No
HPAH	High-Molecular Weight PAHs (sum)	PAHs	0	0.5	32	0.0082	9.19	9.19	NA	1.1	7	1.6	Normal	90% Student's-t UCL	1.46	**Yes**	No	25	1.97	Gamma	90% Adjusted Gamma UCL	1.8	**Yes**	No

Notes:
90UCL - 90th upper confidence limit
mg/kg - milligram per kilogram
min - minimum
max - maximum
COI - constituent of interest
SLV - screening level value
Cij -concentration of COI i in medium j
Tij - toxicity ratios for COI i in medium j
n - sample size

Notes about data included in 90UCL calculations:
90UCLs calculated separately using available discrete or composite riverbank data (results from Historical Substation A not included).
Riverbank locations: Discrete (a, b, c) and composite samples at locations RB-1 through RB-7, PS-S-01-01/Boring 1, Discrete samples (a, b) at RB-8 through RB-15.
Only data from samples collected within 3 ft included in summary.
Data summary (minimums and maximums) based on all available samples (i.e., discrete and composite samples)

90UCLs were calculated using USEPA ProUCL software, version 4.1.01.
1 - Refer to Table 3-1 for background and screening level source information.

APPENDIX D-2 Riverbank Soil 90UCL Calculations - ProUCL Output

General UCL Statistics for Data Sets with Non-Detects

User Selected Options	
From File	proucl_input.wst
Full Precision	OFF
Confidence Coefficient	90%
Number of Bootstrap Operations	2000

StdResult (copper_composite)

General Statistics			
Number of Valid Observations	7	Number of Distinct Observations	7
Raw Statistics		Log-transformed Statistics	
Minimum	33.3	Minimum of Log Data	3.506
Maximum	271	Maximum of Log Data	5.602
Mean	98.27	Mean of log Data	4.387
Geometric Mean	80.43	SD of log Data	0.642
Median	71.3		
SD	79.07		
Std. Error of Mean	29.89		
Coefficient of Variation	0.805		
Skewness	2.246		

Warning: A sample size of 'n' = 7 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 7 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.713	Shapiro Wilk Test Statistic	0.923
Shapiro Wilk Critical Value	0.803	Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	141.3	90% H-UCL	162
		90% Chebyshev (MVUE) UCL	165.6
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	197.3
90% Adjusted-CLT UCL (Chen-1995)	154.7	97.5% Chebyshev (MVUE) UCL	241.3
90% Modified-t UCL (Johnson-1978)	145.5	99% Chebyshev (MVUE) UCL	327.7
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.61	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	61.05		
MLE of Mean	98.27		
MLE of Standard Deviation	77.46		
nu star	22.54		
Approximate Chi Square Value (.05)	14.47	Nonparametric Statistics	
Adjusted Level of Significance	0.0549	90% CLT UCL	136.6
Adjusted Chi Square Value	12.95	90% Jackknife UCL	141.3
		90% Standard Bootstrap UCL	133.9
Anderson-Darling Test Statistic	0.549	90% Bootstrap-t UCL	224.2
Anderson-Darling 5% Critical Value	0.713	90% Hall's Bootstrap UCL	347.1
Kolmogorov-Smirnov Test Statistic	0.288	90% Percentile Bootstrap UCL	134.7
Kolmogorov-Smirnov 5% Critical Value	0.314	90% BCA Bootstrap UCL	152.9
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	187.9
		95% Chebyshev(Mean, Sd) UCL	228.5
		97.5% Chebyshev(Mean, Sd) UCL	284.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	395.6
90% Approximate Gamma UCL (Use when n >= 40)	153		
90% Adjusted Gamma UCL (Use when n < 40)	171		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	
		Recommendation for 95UCL: Use 95% Approximate Gamma UCL	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

APPENDIX D-2 Riverbank Soil 90UCL Calculations - ProUCL Output

StdResult (copper_grab)

General Statistics			
Number of Valid Observations	16	Number of Distinct Observations	15
Raw Statistics		Log-transformed Statistics	
Minimum	25.8	Minimum of Log Data	3.25
Maximum	1640	Maximum of Log Data	7.402
Mean	228	Mean of log Data	4.697
Geometric Mean	109.6	SD of log Data	1.086
Median	82.75		
SD	401.8		
Std. Error of Mean	100.5		
Coefficient of Variation	1.763		
Skewness	3.292		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.514	Shapiro Wilk Test Statistic	0.893
Shapiro Wilk Critical Value	0.887	Shapiro Wilk Critical Value	0.887
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	362.7	90% H-UCL	352
		90% Chebyshev (MVUE) UCL	357
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	433.8
90% Adjusted-CLT UCL (Chen-1995)	415.8	97.5% Chebyshev (MVUE) UCL	540.4
90% Modified-t UCL (Johnson-1978)	376.4	99% Chebyshev (MVUE) UCL	749.8
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.699	Data appear Lognormal at 5% Significance Level	
Theta Star	326.1		
MLE of Mean	228		
MLE of Standard Deviation	272.7		
nu star	22.37		
Approximate Chi Square Value (.05)	14.34	Nonparametric Statistics	
Adjusted Level of Significance	0.0809	90% CLT UCL	356.7
Adjusted Chi Square Value	13.77	90% Jackknife UCL	362.7
		90% Standard Bootstrap UCL	349.6
Anderson-Darling Test Statistic	1.465	90% Bootstrap-t UCL	656.1
Anderson-Darling 5% Critical Value	0.772	90% Hall's Bootstrap UCL	917.8
Kolmogorov-Smirnov Test Statistic	0.291	90% Percentile Bootstrap UCL	351.7
Kolmogorov-Smirnov 5% Critical Value	0.223	90% BCA Bootstrap UCL	439.3
Data not Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	529.4
		95% Chebyshev(Mean, Sd) UCL	665.9
		97.5% Chebyshev(Mean, Sd) UCL	855.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1228
90% Approximate Gamma UCL (Use when n >= 40)	355.7		
90% Adjusted Gamma UCL (Use when n < 40)	370.5		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	
		Recommendation for 95UCL: Use 95% Chebyshev (Mean, Sd) UCL	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

APPENDIX D-2 Riverbank Soil 90UCL Calculations - ProUCL Output

StdResult (lead_composite)

General Statistics			
Number of Valid Observations	7	Number of Distinct Observations	7
Raw Statistics		Log-transformed Statistics	
Minimum	20.1	Minimum of Log Data	3.001
Maximum	85.6	Maximum of Log Data	4.45
Mean	46.61	Mean of log Data	3.761
Geometric Mean	42.97	SD of log Data	0.442
Median	42.6		
SD	20.45		
Std. Error of Mean	7.731		
Coefficient of Variation	0.439		
Skewness	1.103		

Warning: A sample size of 'n' = 7 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 7 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.903	Shapiro Wilk Test Statistic	0.945
Shapiro Wilk Critical Value	0.803	Shapiro Wilk Critical Value	0.803
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	57.74	90% H-UCL	63.78
		90% Chebyshev (MVUE) UCL	70.15
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	80.78
90% Adjusted-CLT UCL (Chen-1995)	58.82	97.5% Chebyshev (MVUE) UCL	95.54
90% Modified-t UCL (Johnson-1978)	58.28	99% Chebyshev (MVUE) UCL	124.5
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	3.702	Data appear Normal at 5% Significance Level	
Theta Star	12.59		
MLE of Mean	46.61		
MLE of Standard Deviation	24.23		
nu star	51.83		
Approximate Chi Square Value (.05)	39.29	Nonparametric Statistics	
Adjusted Level of Significance	0.0549	90% CLT UCL	56.52
Adjusted Chi Square Value	36.66	90% Jackknife UCL	57.74
		90% Standard Bootstrap UCL	55.52
Anderson-Darling Test Statistic	0.345	90% Bootstrap-t UCL	64.19
Anderson-Darling 5% Critical Value	0.709	90% Hall's Bootstrap UCL	72.71
Kolmogorov-Smirnov Test Statistic	0.236	90% Percentile Bootstrap UCL	56.64
Kolmogorov-Smirnov 5% Critical Value	0.313	90% BCA Bootstrap UCL	57.71
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	69.81
		95% Chebyshev(Mean, Sd) UCL	80.31
		97.5% Chebyshev(Mean, Sd) UCL	94.89
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	123.5
90% Approximate Gamma UCL (Use when n >= 40)	61.5		
90% Adjusted Gamma UCL (Use when n < 40)	65.9		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	
		Recommendation for 95UCL: Use 95% Student's-t UCL	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003).   For additional insight, the user may want to consult a statistician.

APPENDIX D-2 Riverbank Soil 90UCL Calculations - ProUCL Output

StdResult (lead_grab)

General Statistics			
Number of Valid Observations	29	Number of Distinct Observations	29
Raw Statistics		Log-transformed Statistics	
Minimum	6.94	Minimum of Log Data	1.937
Maximum	439	Maximum of Log Data	6.084
Mean	64.68	Mean of log Data	3.623
Geometric Mean	37.44	SD of log Data	1.017
Median	33.6		
SD	87.62		
Std. Error of Mean	16.27		
Coefficient of Variation	1.355		
Skewness	3.206		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.62	Shapiro Wilk Test Statistic	0.973
Shapiro Wilk Critical Value	0.926	Shapiro Wilk Critical Value	0.926
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	86.03	90% H-UCL	89.68
		90% Chebyshev (MVUE) UCL	101.1
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	119.2
90% Adjusted-CLT UCL (Chen-1995)	92.44	97.5% Chebyshev (MVUE) UCL	144.3
90% Modified-t UCL (Johnson-1978)	87.65	99% Chebyshev (MVUE) UCL	193.6
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.964	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	67.06		
MLE of Mean	64.68		
MLE of Standard Deviation	65.86		
nu star	55.94		
Approximate Chi Square Value (.05)	42.88	Nonparametric Statistics	
Adjusted Level of Significance	0.0897	90% CLT UCL	85.53
Adjusted Chi Square Value	42.34	90% Jackknife UCL	86.03
		90% Standard Bootstrap UCL	85.07
Anderson-Darling Test Statistic	0.851	90% Bootstrap-t UCL	106
Anderson-Darling 5% Critical Value	0.773	90% Hall's Bootstrap UCL	168.9
Kolmogorov-Smirnov Test Statistic	0.142	90% Percentile Bootstrap UCL	86.6
Kolmogorov-Smirnov 5% Critical Value	0.167	90% BCA Bootstrap UCL	93.88
Data follow Appr. Gamma Distribution at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	113.5
		95% Chebyshev(Mean, Sd) UCL	135.6
		97.5% Chebyshev(Mean, Sd) UCL	166.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	226.6
90% Approximate Gamma UCL (Use when n >= 40)	84.37		
90% Adjusted Gamma UCL (Use when n < 40)	85.44		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	
		Recommendation for 95UCL: Use 95% Approximate Gamma UCL	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

APPENDIX D-2 Riverbank Soil 90UCL Calculations - ProUCL Output

StdResult (zinc_composite)

General Statistics			
Number of Valid Observations	7	Number of Distinct Observations	7
Raw Statistics		Log-transformed Statistics	
Minimum	121	Minimum of Log Data	4.796
Maximum	835	Maximum of Log Data	6.727
Mean	307.4	Mean of log Data	5.525
Geometric Mean	251	SD of log Data	0.644
Median	246		
SD	246		
Std. Error of Mean	92.97		
Coefficient of Variation	0.8		
Skewness	2.103		

Warning: A sample size of 'n' = 7 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 7 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.745	Shapiro Wilk Test Statistic	0.93
Shapiro Wilk Critical Value	0.803	Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	441.3	90% H-UCL	507.7
		90% Chebyshev (MVUE) UCL	518.1
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	617.5
90% Adjusted-CLT UCL (Chen-1995)	479.3	97.5% Chebyshev (MVUE) UCL	755.4
90% Modified-t UCL (Johnson-1978)	453.6	99% Chebyshev (MVUE) UCL	1026
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.592	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	193.1		
MLE of Mean	307.4		
MLE of Standard Deviation	243.7		
nu star	22.28		
Approximate Chi Square Value (.05)	14.27	Nonparametric Statistics	
Adjusted Level of Significance	0.0549	90% CLT UCL	426.6
Adjusted Chi Square Value	12.76	90% Jackknife UCL	441.3
		90% Standard Bootstrap UCL	418.4
Anderson-Darling Test Statistic	0.453	90% Bootstrap-t UCL	651.4
Anderson-Darling 5% Critical Value	0.713	90% Hall's Bootstrap UCL	1015
Kolmogorov-Smirnov Test Statistic	0.226	90% Percentile Bootstrap UCL	421
Kolmogorov-Smirnov 5% Critical Value	0.314	90% BCA Bootstrap UCL	493.6
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	586.4
		95% Chebyshev(Mean, Sd) UCL	712.7
		97.5% Chebyshev(Mean, Sd) UCL	888.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1233
90% Approximate Gamma UCL (Use when n >= 40)	480.1		
90% Adjusted Gamma UCL (Use when n < 40)	536.9		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	
		Recommendation for 95UCL: Use 95% Approximate Gamma UCL	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003).   For additional insight, the user may want to consult a statistician.

APPENDIX D-2 Riverbank Soil 90UCL Calculations - ProUCL Output

StdResult (zinc_grab)

General Statistics			
Number of Valid Observations	16	Number of Distinct Observations	16
Raw Statistics		Log-transformed Statistics	
Minimum	42.3	Minimum of Log Data	3.745
Maximum	708	Maximum of Log Data	6.562
Mean	169.8	Mean of log Data	4.862
Geometric Mean	129.3	SD of log Data	0.684
Median	115		
SD	168.5		
Std. Error of Mean	42.13		
Coefficient of Variation	0.993		
Skewness	2.66		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.624	Shapiro Wilk Test Statistic	0.896
Shapiro Wilk Critical Value	0.887	Shapiro Wilk Critical Value	0.887
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	226.2	90% H-UCL	219.3
		90% Chebyshev (MVUE) UCL	247.6
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	287
90% Adjusted-CLT UCL (Chen-1995)	243.8	97.5% Chebyshev (MVUE) UCL	341.7
90% Modified-t UCL (Johnson-1978)	230.9	99% Chebyshev (MVUE) UCL	449.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.657	Data appear Lognormal at 5% Significance Level	
Theta Star	102.5		
MLE of Mean	169.8		
MLE of Standard Deviation	131.9		
nu star	53.02		
Approximate Chi Square Value (.05)	40.32	Nonparametric Statistics	
Adjusted Level of Significance	0.0809	90% CLT UCL	223.7
Adjusted Chi Square Value	39.33	90% Jackknife UCL	226.2
		90% Standard Bootstrap UCL	221.5
Anderson-Darling Test Statistic	1.317	90% Bootstrap-t UCL	325.1
Anderson-Darling 5% Critical Value	0.75	90% Hall's Bootstrap UCL	539.8
Kolmogorov-Smirnov Test Statistic	0.3	90% Percentile Bootstrap UCL	225.8
Kolmogorov-Smirnov 5% Critical Value	0.218	90% BCA Bootstrap UCL	244
Data not Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	296.1
		95% Chebyshev(Mean, Sd) UCL	353.4
		97.5% Chebyshev(Mean, Sd) UCL	432.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	589
90% Approximate Gamma UCL (Use when n >= 40)	223.2		
90% Adjusted Gamma UCL (Use when n < 40)	228.9		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	
		Recommendation for 95UCL: Use 95% H-UCL	

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003).   For additional insight, the user may want to consult a statistician.

APPENDIX D-2 Riverbank Soil 90UCL Calculations - ProUCL Output

StdResult (high-molecular weight pahs (sum)_composite)

General Statistics			
Number of Valid Observations	7	Number of Distinct Observations	7
Raw Statistics		Log-transformed Statistics	
Minimum	0.26	Minimum of Log Data	-1.348
Maximum	2.984	Maximum of Log Data	1.093
Mean	1.066	Mean of log Data	-0.283
Geometric Mean	0.753	SD of log Data	0.888
Median	0.74		
SD	0.997		
Std. Error of Mean	0.377		
Coefficient of Variation	0.935		
Skewness	1.481		

Warning: A sample size of 'n' = 7 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 7 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.815	Shapiro Wilk Test Statistic	0.943
Shapiro Wilk Critical Value	0.803	Shapiro Wilk Critical Value	0.803
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	1.609	90% H-UCL	2.537
		90% Chebyshev (MVUE) UCL	2.099
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	2.578
90% Adjusted-CLT UCL (Chen-1995)	1.7	97.5% Chebyshev (MVUE) UCL	3.242
90% Modified-t UCL (Johnson-1978)	1.644	99% Chebyshev (MVUE) UCL	4.547
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.002	Data appear Normal at 5% Significance Level	
Theta Star	1.065		
MLE of Mean	1.066		
MLE of Standard Deviation	1.065		
nu star	14.02		
Approximate Chi Square Value (.05)	7.806	Nonparametric Statistics	
Adjusted Level of Significance	0.0549	90% CLT UCL	1.549
Adjusted Chi Square Value	6.731	90% Jackknife UCL	1.609
		90% Standard Bootstrap UCL	1.513
Anderson-Darling Test Statistic	0.366	90% Bootstrap-t UCL	1.972
Anderson-Darling 5% Critical Value	0.72	90% Hall's Bootstrap UCL	1.696
Kolmogorov-Smirnov Test Statistic	0.215	90% Percentile Bootstrap UCL	1.539
Kolmogorov-Smirnov 5% Critical Value	0.317	90% BCA Bootstrap UCL	1.642
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	2.196
		95% Chebyshev(Mean, Sd) UCL	2.708
		97.5% Chebyshev(Mean, Sd) UCL	3.419
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	4.815
90% Approximate Gamma UCL (Use when n >= 40)	1.915		
90% Adjusted Gamma UCL (Use when n < 40)	2.221		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	
		Recommendation for 95UCL: Use 95% Student's-t UCL	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003).   For additional insight, the user may want to consult a statistician.

APPENDIX D-2 Riverbank Soil 90UCL Calculations - ProUCL Output

StdResult (high-molecular weight pahs (sum)_grab)

General Statistics			
Number of Valid Observations	25	Number of Distinct Observations	25
Raw Statistics		Log-transformed Statistics	
Minimum	0.0082	Minimum of Log Data	-4.804
Maximum	9.19	Maximum of Log Data	2.218
Mean	1.404	Mean of log Data	-0.341
Geometric Mean	0.711	SD of log Data	1.384
Median	0.788		
SD	1.912		
Std. Error of Mean	0.382		
Coefficient of Variation	1.362		
Skewness	3.209		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.622	Shapiro Wilk Test Statistic	0.919
Shapiro Wilk Critical Value	0.918	Shapiro Wilk Critical Value	0.918
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
90% Student's-t UCL	1.908	90% H-UCL	3.474
		90% Chebyshev (MVUE) UCL	3.474
90% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	4.264
90% Adjusted-CLT UCL (Chen-1995)	2.069	97.5% Chebyshev (MVUE) UCL	5.36
90% Modified-t UCL (Johnson-1978)	1.949	99% Chebyshev (MVUE) UCL	7.513
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.787	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	1.785		
MLE of Mean	1.404		
MLE of Standard Deviation	1.583		
nu star	39.33		
Approximate Chi Square Value (.05)	28.48	Nonparametric Statistics	
Adjusted Level of Significance	0.0883	90% CLT UCL	1.894
Adjusted Chi Square Value	27.99	90% Jackknife UCL	1.908
		90% Standard Bootstrap UCL	1.882
Anderson-Darling Test Statistic	0.404	90% Bootstrap-t UCL	2.387
Anderson-Darling 5% Critical Value	0.779	90% Hall's Bootstrap UCL	4.637
Kolmogorov-Smirnov Test Statistic	0.117	90% Percentile Bootstrap UCL	1.889
Kolmogorov-Smirnov 5% Critical Value	0.181	90% BCA Bootstrap UCL	2.117
Data appear Gamma Distributed at 5% Significance Level		90% Chebyshev(Mean, Sd) UCL	2.551
		95% Chebyshev(Mean, Sd) UCL	3.071
		97.5% Chebyshev(Mean, Sd) UCL	3.792
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	5.209
90% Approximate Gamma UCL (Use when n >= 40)	1.939		
90% Adjusted Gamma UCL (Use when n < 40)	1.973		
Potential UCL to Use		Recommendation Provided only for 95% Confidence Coefficient	
		Recommendation for 95UCL: Use 95% Approximate Gamma UCL	

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

APPENDIX E
Substation A Surface Soil Results

APPENDIX E-1 Historical Substation A Soil Summary and Risk Screening

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Plants)

Constituents of Interest (COI)				Date		Depth Range (ft)		Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background?	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs [2]	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/Methods	Units	Min	Max	Min	Max	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)			Cij	Tij			Tij/Tj		
12674-11-2	Aroclor 1016	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0055	0.0058			0.0058	NA	NA	NA	No det	NA	No	No	---	---	---
11104-28-2	Aroclor 1221	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0028	0.0029			0.0029	NA	NA	NA	No det	NA	No	No	---	---	---
11141-16-5	Aroclor 1232	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0038	0.004			0.004	NA	NA	NA	No det	NA	No	No	---	---	---
53469-21-9	Aroclor 1242	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0051	0.0053			0.0053	NA	NA	NA	No det	NA	No	No	---	---	---
12672-29-6	Aroclor 1248	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0049	0.0051			0.0051	NA	NA	NA	No det	NA	No	No	---	---	---
11097-69-1	Aroclor 1254	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0029	0.0031			0.0031	NA	NA	NA	No det	NA	No	No	---	---	---
11096-82-5	Aroclor 1260	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	1	0.5	0.0062	0.0062	0.0248	0.0248	0.0248	NA	NA	NA	0.0248	NA	No	No	---	---	---
37324-23-5	Aroclor 1262	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0035	0.0036			0.0036	NA	NA	NA	No det	NA	No	No	---	---	---
11100-14-4	Aroclor 1268	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0016	0.0017			0.0017	NA	NA	NA	No det	NA	No	No	---	---	---
1336-36-3	Total Aroclors	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	1	0.5	0.0062	0.0062	0.0248	0.0248	0.0248	NA	NA	40	0.0248	0.001	No	No	---	---	---
DRO	Diesel-Range	TPH (NWTPH-Dx)	mg/kg	40590	40590	0	1	2	1	0.5	3.8	3.8	5.2	5.2	5.2	NA	NA	NA	5.2	NA	No	No	---	---	---
RRO	Residual-Range	TPH (NWTPH-Dx)	mg/kg	40590	40590	0	1	2	1	0.5	25.4	25.4	31.5	31.5	31.5	NA	NA	NA	31.5	NA	No	No	---	---	---

Tj = Sum of toxicity ratios for all COIs in medium j 0.001
Nij = Number of i COIs in medium j 1.000

1/Nij= 0.000

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Invertebrates)

Constituents of Interest (COI)				Date		Depth Range (ft)		Samples			Non-detected Concentrations		Detected Concentrations		Overall Max	Background Levels[1]	Max COI Conc. Exceeds Background?	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	COI Conc. (max)	Risk Ratio for Individual COI	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Risk Ratio for Multiple COIs [2]	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
CASNo	Analyte	Analyte Group/Methods	Units	Min	Max	Min	Max	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max		Natural Background Soil Concs (mg/kg)			Cij	Tij			Tij/Tj		
12674-11-2	Aroclor 1016	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0055	0.0058			0.0058	NA	NA	NA	No det	NA	No	No	---	---	---
11104-28-2	Aroclor 1221	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0028	0.0029			0.0029	NA	NA	NA	No det	NA	No	No	---	---	---
11141-16-5	Aroclor 1232	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0038	0.004			0.004	NA	NA	NA	No det	NA	No	No	---	---	---
53469-21-9	Aroclor 1242	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0051	0.0053			0.0053	NA	NA	NA	No det	NA	No	No	---	---	---
12672-29-6	Aroclor 1248	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0049	0.0051			0.0051	NA	NA	NA	No det	NA	No	No	---	---	---
11097-69-1	Aroclor 1254	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0029	0.0031			0.0031	NA	NA	NA	No det	NA	No	No	---	---	---
11096-82-5	Aroclor 1260	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	1	0.5	0.0062	0.0062	0.0248	0.0248	0.0248	NA	NA	NA	0.0248	NA	No	No	---	---	---
37324-23-5	Aroclor 1262	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0035	0.0036			0.0036	NA	NA	NA	No det	NA	No	No	---	---	---
11100-14-4	Aroclor 1268	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0016	0.0017			0.0017	NA	NA	NA	No det	NA	No	No	---	---	---
1336-36-3	Total Aroclors	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	1	0.5	0.0062	0.0062	0.0248	0.0248	0.0248	NA	NA	NA	0.0248	NA	No	No	---	---	---
DRO	Diesel-Range	TPH (NWTPH-Dx)	mg/kg	40590	40590	0	1	2	1	0.5	3.8	3.8	5.2	5.2	5.2	NA	NA	200	5.2	0.026	No	No	---	---	---
RRO	Residual-Range	TPH (NWTPH-Dx)	mg/kg	40590	40590	0	1	2	1	0.5	25.4	25.4	31.5	31.5	31.5	NA	NA	NA	31.5	NA	No	No	---	---	---

Tj = Sum of toxicity ratios for all COIs in medium j 0.026
Nij = Number of i COIs in medium j 1

1/Nij= 1

APPENDIX E-1 Historical Substation A Soil Summary and Risk Screening

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Birds)

Constituents of Interest (COI)				Date		Depth Range (ft)		Samples			Non-detected Concentrations		Detected Concentrations			Background Levels[1]			COI Conc. (max)	Risk Ratio for Individual COI			Risk Ratio for Multiple COIs		
CASNo	Analyte	Analyte Group/Methods	Units	Min	Max	Min	Max	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max	Overall Max	Natural Background Soil Concs (mg/kg)	Max COI Conc. Exceeds Background?	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	Cij	Tij	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Tij/Tj	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
12674-11-2	Aroclor 1016	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0055	0.0058			0.0058	NA	NA	0.7	No det	0.008	No	No	0.072	No	No
11104-28-2	Aroclor 1221	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0028	0.0029			0.0029	NA	NA	0.7	No det	0.004	No	No	0.036	No	No
11141-16-5	Aroclor 1232	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0038	0.004			0.004	NA	NA	0.7	No det	0.006	No	No	0.050	No	No
53469-21-9	Aroclor 1242	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0051	0.0053			0.0053	NA	NA	1.5	No det	0.004	No	No	0.031	No	No
12672-29-6	Aroclor 1248	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0049	0.0051			0.0051	NA	NA	0.7	No det	0.007	No	No	0.063	No	No
11097-69-1	Aroclor 1254	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0029	0.0031			0.0031	NA	NA	0.7	No det	0.004	No	No	0.038	No	No
11096-82-5	Aroclor 1260	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	1	0.5	0.0062	0.0062	0.0248	0.0248	0.0248	NA	NA	0.7	0.0248	0.035	No	No	0.307	**Yes**	No
37324-23-5	Aroclor 1262	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0035	0.0036			0.0036	NA	NA	0.7	No det	0.005	No	No	0.045	No	No
11100-14-4	Aroclor 1268	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0016	0.0017			0.0017	NA	NA	0.7	No det	0.002	No	No	0.021	No	No
1336-36-3	Total Aroclors	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	1	0.5	0.0062	0.0062	0.0248	0.0248	0.0248	NA	NA	0.65	0.0248	0.038	No	No	0.331	**Yes**	No
DRO	Diesel-Range	TPH (NWTPH-Dx)	mg/kg	40590	40590	0	1	2	1	0.5	3.8	3.8	5.2	5.2	5.2	NA	NA	6000	5.2	0.001	No	No	0.008	No	No
RRO	Residual-Range	TPH (NWTPH-Dx)	mg/kg	40590	40590	0	1	2	1	0.5	25.4	25.4	31.5	31.5	31.5	NA	NA	NA	31.5	NA	No	No	NA	No	No

Tj = Sum of toxicity ratios for all COIs in medium j   0.115

Nij = Number of i COIs in medium j   11.000

1/Nij=   0.091

Swan Island OU2 Upland Facility - Oregon Screening Levels (Receptors - Mammals)

Constituents of Interest (COI)				Date		Depth Range (ft)		Samples			Non-detected Concentrations		Detected Concentrations			Background Levels[1]			COI Conc. (max)	Risk Ratio for Individual COI			Risk Ratio for Multiple COIs		
CASNo	Analyte	Analyte Group/Methods	Units	Min	Max	Min	Max	Number of Samples	Number of Non-detects	Detection Frequency	Min	Max	Min	Max	Overall Max	Natural Background Soil Concs (mg/kg)	Max COI Conc. Exceeds Background?	Oregon DEQ-Approved Level II SLVs (mg/kg) [1]	Cij	Tij	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Individual COI Risk? (Q=5)	Tij/Tj	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=1) (T&E)	Max COI Conc. Exceeds SLV - Multiple COI Risk? (Q=5)
12674-11-2	Aroclor 1016	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0055	0.0058			0.0058	NA	NA	100	No det	0.0001	No	No	0.001	No	No
11104-28-2	Aroclor 1221	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0028	0.0029			0.0029	NA	NA	4	No det	0.001	No	No	0.009	No	No
11141-16-5	Aroclor 1232	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0038	0.004			0.004	NA	NA	4	No det	0.001	No	No	0.012	No	No
53469-21-9	Aroclor 1242	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0051	0.0053			0.0053	NA	NA	5	No det	0.001	No	No	0.013	No	No
12672-29-6	Aroclor 1248	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0049	0.0051			0.0051	NA	NA	4	No det	0.001	No	No	0.016	No	No
11097-69-1	Aroclor 1254	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0029	0.0031			0.0031	NA	NA	4	No det	0.001	No	No	0.010	No	No
11096-82-5	Aroclor 1260	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	1	0.5	0.0062	0.0062	0.0248	0.0248	0.0248	NA	NA	4	0.0248	0.006	No	No	0.077	No	No
37324-23-5	Aroclor 1262	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0035	0.0036			0.0036	NA	NA	4	No det	0.001	No	No	0.011	No	No
11100-14-4	Aroclor 1268	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	2	0	0.0016	0.0017			0.0017	NA	NA	4	No det	0.000	No	No	0.005	No	No
1336-36-3	Total Aroclors	PCBs_Aroclors	mg/kg	40590	40590	0	1	2	1	0.5	0.0062	0.0062	0.0248	0.0248	0.0248	NA	NA	0.371	0.0248	0.067	No	No	0.834	Yes	**Yes**
DRO	Diesel-Range	TPH (NWTPH-Dx)	mg/kg	40590	40590	0	1	2	1	0.5	3.8	3.8	5.2	5.2	5.2	NA	NA	6000	5.2	0.001	No	No	0.011	No	No
RRO	Residual-Range	TPH (NWTPH-Dx)	mg/kg	40590	40590	0	1	2	1	0.5	25.4	25.4	31.5	31.5	31.5	NA	NA	NA	31.5	NA	No	No	NA	No	No

Tj = Sum of toxicity ratios for all COIs in medium j   0.080

Nij = Number of i COIs in medium j   11.000

1/Nij=   0.091

Notes about data included in summary:

All available data for riverbank locations (both composite and corresponding discrete sub-samples) from 2006 through 2011 are included in summary.

Screen based on two composite samples collected from Historical Substation A.

Only data from samples collected within 3 ft included in summary.

Acronyms:

- DEQ - Oregon Department of Environmental Quality
- EPA - U.S. Environmental Protection Agency
- ND - non-detect
- mg/kg - milligram per kilogram
- min - minimum
- max - maximum
- NA - not available
- <5%D - less than 5% detection frequency
- COI - constituent of interest
- SLV - screening level value
- Cij -concentration of COI i in medium j
- Tij - toxicity ratios for COI i in medium j
- T&E - listed threatened and endangered species
- Q = 1 for T&E species
- Q = 5 for non-T&E species
- --- = not applicable

1 - Refer to Table 3-1 for background and screening level source information.

2 - Comparison to multiple COIs is not appropriate in cases where there is only one SLV available for COIs for a particular receptor.

APPENDIX F
Calculation Worksheets for Population-level Probabilistic Risk Analyses

Appendix F-1 Calculation Worksheets for Population-level Probabilistic Risk Analyses - Zinc (discrete samples)

Swan Island OU2 Upland Facility

Analysis of probability of exposure exceeding Acceptable Risk Levels

RECEPTOR: AMERICAN ROBIN - 100% Invertebrate Diet

Exposure Parameters	Value	Unit
IRsoil	0.1515	kg soil/kg food
IRfood	0.207	kg dw/kg bw-d
Pplant	0	fraction
Pearthworm	1	fraction
Soil bioavailability factor	1	unitless

CHEMICAL: **Zinc** **Discrete samples only**

LOCATION	Concentration of Chemical in Soil		Dose of Chemical	
	Csoil (mg/kg)	ln(Csoil)	Dose (mg/kg BW/day)	ln(dose)
RB-15a	83.10	4.42	78.08	4.36
RB-15b	129.00	4.86	91.23	4.51
RB-14b	118.00	4.77	88.37	4.48
RB-8b	98.00	4.58	82.74	4.42
RB-9a	206.00	5.33	108.11	4.68
RB-14a	114.00	4.74	87.29	4.47
RB-10a	110.00	4.70	86.19	4.46
RB-12a	127.00	4.84	90.72	4.51
RB-13b	77.20	4.35	76.09	4.33
RB-10b	708.00	6.56	174.59	5.16
RB-13a	42.30	3.74	61.80	4.12
RB-11a	116.00	4.75	87.83	4.48
RB-11b	107.00	4.67	85.35	4.45
RB-8a	428.00	6.06	142.62	4.96
RB-12b	65.40	4.18	71.82	4.27
RB-9b	187.00	5.23	104.34	4.65

STATISTICS				
	mg/kg	ln	mg/kg BW/day	ln
Average	169.75	4.86	94.8	4.52
Standard Deviation	168.5	0.68	27.9	0.25
Distribution			log normal	

PROBABILISTIC ANALYSIS - log based calculations				
Number of animals (n)		49		
EBV (mg/kg/day)	**ln(EBV)**	**Individual Probability of Exp>EBV (p)**	**Probability that more than 20% of the local population will experience Exp>EBV (b)**	**where b=1-BINOMDIST(#kills,#trials,prob of kill,cumulative)**
14.5	2.67	1.00	1.00	**Acceptable Risk Level (ARL) for non T/E Species: probability <0.1**
55.0	4.01	0.98	1.00	
66.1	4.19	0.90	1.00	
68.8	4.23	0.87	1.00	
87.1	4.47	0.58	1.00	
110.5	4.71	0.23	0.72	
131	4.88	0.08	0.004	
144.8	4.98	0.04	0.00000700	
271	5.60	0.00	0.00000000	

Notes:

- Refer to Table 4-1 for description of all exposure parameters and intake/dose equations.
- Refer to Table 4-2 for description of all ecological benchmark values (EBV).
- Refer to text for description of calculation of number of individuals.
- All locations are within the riverbank area of Swan Island OU2 Upland Facility; analysis assumes even distribution across riverbank area.
- Method Source: Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final. April 1998, updated December 2001.
- Acceptable risk level (ARL)[OAR 340-122-115(6)] for populations of ecological receptors is a 10% or less chance that 20% or more of the total local population would receive an exposure greater than the EBV.

Appendix F-2 Calculation Worksheets for Population-level Probabilistic Risk Analyses - Zinc (composite samples)

Swan Island OU2 Upland Facility

Analysis of probability of exposure exceeding Acceptable Risk Levels

RECEPTOR: AMERICAN ROBIN - 100% Invertebrate Diet

Exposure Parameters	Value	Unit
IRsoil	0.1515	kg soil/kg food
IRfood	0.207	kg dw/kg bw-d
Pplant	0	fraction
Pearthworm	1	fraction
Soil bioavailability factor	1	unitless

CHEMICAL: **Zinc** **Composite samples only**

LOCATION	Concentration of Chemical in Soil		Dose of Chemical	
	Csoil (mg/kg)	ln(Csoil)	Dose (mg/kg BW/day)	ln(dose)
RB-1 Composite	835.00	6.73	187.05	5.23
RB-3 Composite	264.00	5.58	118.54	4.78
RB-4 Composite	153.00	5.03	97.00	4.57
RB-6 Composite	359.00	5.88	133.22	4.89
RB-7 Composite	121.00	4.80	89.16	4.49
RB-5 Composite	246.00	5.51	115.45	4.75
RB-2 Composite	174.00	5.16	101.63	4.62

STATISTICS				
	mg/kg	ln	mg/kg BW/day	ln
Average	307.43	5.53	120.3	4.76
Standard Deviation	246.0	0.64	32.9	0.25
Distribution			log normal	

PROBABILISTIC ANALYSIS - log based calculations				
	Number of animals (n)	49		
EBV (mg/kg/day)	**ln(EBV)**	**Individual Probability of Exp>EBV (p)**	**Probability that more than 20% of the local population will experience Exp>EBV (b)**	**where b=1-BINOMDIST(#kills,#trials,prob of kill,cumulative)**
14.5	2.67	1.00	0.00	**Acceptable Risk Level (ARL) for non T/E Species: probability <0.1**
55.0	4.01	1.00	1.00	
66.1	4.19	0.99	1.00	
68.8	4.23	0.98	1.00	
87.1	4.47	0.88	1.00	
110.5	4.71	0.59	1.00	
131	4.88	0.32	0.98	
144.8	4.98	0.19	0.49	
271	5.60	0.00	0.0000000	

Notes:

- Refer to Table 4-1 for description of all exposure parameters and intake/dose equations.
- Refer to Table 4-2 for description of all ecological benchmark values (EBV).
- Refer to text for description of calculation of number of individuals.
- All locations are within the riverbank area of Swan Island OU2 Upland Facility; analysis assumes even distribution across riverbank area.
- Method Source: Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final. April 1998, updated December 2001.
- Acceptable risk level (ARL)[OAR 340-122-115(6)] for populations of ecological receptors is a 10% or less chance that 20% or more of the total local population would receive an exposure greater than the EBV.

Appendix F-3 Calculation Worksheets for Population-level Probabilistic Risk Analyses - Lead (discrete samples)

Swan Island OU2 Upland Facility

Analysis of probability of exposure exceeding Acceptable Risk Levels

RECEPTOR: AMERICAN ROBIN - 100% Invertebrate Diet

Exposure Parameters	Value	Unit
IRsoil	0.1515	kg soil/kg food
IRfood	0.207	kg dw/kg bw-d
Pplant	0	fraction
Pearthworm	1	fraction
Soil bioavailability factor	0.5	unitless

CHEMICAL: LEAD **Discrete samples only**

LOCATION	Concentration of Chemical in Soil		Dose of Chemical	
	Csoil (mg/kg)	ln(Csoil)	Dose (mg/kg BW/day)	ln(dose)
RB-14a	15.40	2.73	1.75	0.56
RB-15b	53.30	3.98	4.95	1.60
RB-12b	17.10	2.84	1.91	0.65
RB-15a	14.10	2.65	1.63	0.49
RB-5a	30.10	3.40	3.07	1.12
RB-5b	15.20	2.72	1.73	0.55
RB-5c	6.94	1.94	0.90	-0.10
RB-6a	58.20	4.06	5.33	1.67
RB-13a	7.40	2.00	0.95	-0.05
RB-6b	87.50	4.47	7.52	2.02
RB-7c	18.50	2.92	2.04	0.71
RB-13b	12.00	2.48	1.42	0.35
RB-6c	33.60	3.51	3.37	1.21
RB-14b	51.30	3.94	4.80	1.57
RB-8b	21.40	3.06	2.31	0.84
RB-9b	78.20	4.36	6.84	1.92
RB-7a	84.20	4.43	7.28	1.98
RB-4a	27.20	3.30	2.82	1.04
RB-10b	439.00	6.08	29.47	3.38
RB-4b	170.00	5.14	13.17	2.58
RB-4c	91.40	4.52	7.80	2.05
RB-9a	225.00	5.42	16.70	2.82
RB-11a	23.20	3.14	2.47	0.90
RB-10a	35.00	3.56	3.48	1.25
RB-11b	42.60	3.75	4.11	1.41
RB-7b	104.00	4.64	8.69	2.16
RB-8a	77.60	4.35	6.79	1.92
PS-S-01-01	11.60	2.45	1.39	0.33
RB-12a	24.60	3.20	2.59	0.95

STATISTICS				
	mg/kg	ln	mg/kg BW/day	ln
Average	64.7	3.62	5.4	1.31
Standard Deviation	87.6	1.02	5.9	0.85
Distribution			log normal	

PROBABILISTIC ANALYSIS - log based calculations				
Number of animals (n)		49		
EBV (mg/kg/day)	**ln(EBV)**	**Individual Probability of Exp>EBV (p)**	**Probability that more than 20% of the local population will experience Exp>EBV (b)**	**where b=1-BINOMDIST(#kills,#trials, prob of kill,cumulative)**
1.13	0.12	0.917	1.00	**Acceptable Risk Level (ARL) for non T/E Species: probability <0.1**
1.63	0.49	0.831	1.00	
10.9	2.39	0.102	0.03	
11.3	2.42	0.095	0.02	
22	3.09	0.018	0.00000002	

Notes:

- Refer to Table 4-1 for description of all exposure parameters and intake/dose equations.
- Refer to Table 4-2 for description of all ecological benchmark values (EBV).
- Refer to text for description of calculation of number of individuals.
- All locations are within the riverbank area of Swan Island OU2 Upland Facility; analysis assumes even distribution across riverbank area.
- Method Source: Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final. April 1998, updated December 2001.
- Acceptable risk level (ARL)[OAR 340-122-115(6)] for populations of ecological receptors is a 10% or less chance that 20% or more of the total local population would receive an exposure greater than the EBV.

Appendix F-4 Calculation Worksheets for Population-level Probabilistic Risk Analyses - Lead (composite samples)

Swan Island OU2 Upland Facility

Analysis of probability of exposure exceeding Acceptable Risk Levels

RECEPTOR: AMERICAN ROBIN - 100% Invertebrate Diet

Exposure Parameters	Value	Unit
IRsoil	0.1515	kg soil/kg food
IRfood	0.207	kg dw/kg bw-d
Pplant	0	fraction
Pearthworm	1	fraction
Soil bioavailability factor	0.5	unitless

CHEMICAL: LEAD **Composite samples only**

LOCATION	Concentration of Chemical in Soil		Dose of Chemical	
	Csoil (mg/kg)	ln(Csoil)	Dose (mg/kg BW/day)	ln(dose)
RB-6 Composite	42.60	3.75	4.11	1.41
RB-2 Composite	43.20	3.77	4.15	1.42
RB-1 Composite	85.60	4.45	7.38	2.00
RB-7 Composite	57.50	4.05	5.28	1.66
RB-5 Composite	20.10	3.00	2.19	0.78
RB-4 Composite	41.30	3.72	4.00	1.39
RB-3 Composite	36.00	3.58	3.57	1.27

STATISTICS				
	mg/kg	ln	mg/kg BW/day	ln
Average	46.61	3.76	4.4	1.42
Standard Deviation	20.5	0.44	1.6	0.37
Distribution			log normal	

PROBABILISTIC ANALYSIS - log based calculations				
	Number of animals (n)	49		
EBV (mg/kg/day)	ln(EBV)	Individual Probability of Exp>EBV (p)	Probability that more than 20% of the local population will experience Exp>EBV (b)	where b=1-BINOMDIST(#kills,#trials,prob of kill,cumulative)
1.13	0.12	1.000	1.00	Acceptable Risk Level (ARL) for non T/E Species: probability <0.1
1.63	0.49	0.994	1.00	
10.9	2.39	0.004	0.0000000000	
11.3	2.42	0.003	0.0000000000	
22	3.09	0.000003	0.0000000000	

Notes:

- Refer to Table 4-1 for description of all exposure parameters and intake/dose equations.
- Refer to Table 4-2 for description of all ecological benchmark values (EBV).
- Refer to text for description of calculation of number of individuals.
- All locations are within the riverbank area of Swan Island OU2 Upland Facility; analysis assumes even distribution across riverbank area.
- Method Source: Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final. April 1998, updated December 2001.
- Acceptable risk level (ARL)[OAR 340-122-115(6)] for populations of ecological receptors is a 10% or less chance that 20% or more of the total local population would receive an exposure greater than the EBV.

Appendix F-5 Calculation Worksheets for Population-level Probabilistic Risk Analyses - Copper (discrete samples)

Swan Island OU2 Upland Facility

Analysis of probability of exposure exceeding Acceptable Risk Levels

RECEPTOR: AMERICAN ROBIN - 100% Invertebrate Diet

Exposure Parameters	Value	Unit
IRsoil	0.1515	kg soil/kg food
IRfood	0.207	kg dw/kg bw-d
Pplant	0	fraction
Pearthworm	1	fraction
Soil bioavailability factor	1	unitless

CHEMICAL: **Copper** **Discrete samples only**

LOCATION	Concentration of Chemical in Soil		Dose of Chemical	
	Csoil (mg/kg)	ln(Csoil)	Dose (mg/kg BW/day)	ln(dose)
RB-9a	298.00	5.70	41.11	3.72
RB-12b	42.40	3.75	5.85	1.77
RB-11a	57.20	4.05	7.89	2.07
RB-14a	46.70	3.84	6.44	1.86
RB-13b	567.00	6.34	78.23	4.36
RB-9b	284.00	5.65	39.18	3.67
RB-10b	1640.00	7.40	226.26	5.42
RB-11b	125.00	4.83	17.25	2.85
RB-10a	112.00	4.72	15.45	2.74
RB-13a	25.80	3.25	3.56	1.27
RB-15a	50.70	3.93	6.99	1.95
RB-15b	103.00	4.63	14.21	2.65
RB-8b	60.10	4.10	8.29	2.12
RB-8a	112.00	4.72	15.45	2.74
RB-12a	61.40	4.12	8.47	2.14
RB-14b	62.50	4.14	8.62	2.15

STATISTICS				
	mg/kg	ln	mg/kg BW/day	ln
Average	228.0	4.70	31.5	2.72
Standard Deviation	401.8	1.09	55.4	1.09
Distribution			log normal	

PROBABILISTIC ANALYSIS - log based calculations				
Number of animals (n)		49		
EBV (mg/kg/day)	ln(EBV)	Individual Probability of Exp>EBV (p)	Probability that more than 20% of the local population will experience Exp>EBV (b)	where b=1-BINOMDIST(#kills,#trials,prob of kill,cumulative)
4.05	1.40	0.887	1.00	Acceptable Risk Level (ARL) for non T/E Species: probability <0.1
18.5	2.92	0.426	1.00	
20.8	3.03	0.385	1.00	
22	3.09	0.365	1.00	
28.7	3.36	0.278	0.91	
42	3.74	0.174	0.34	
68.4	4.23	0.082	0.01	

Notes:

- Refer to Table 4-1 for description of all exposure parameters and intake/dose equations.
- Refer to Table 4-2 for description of all ecological benchmark values (EBV).
- Refer to text for description of calculation of number of individuals.
- All locations are within the riverbank area of Swan Island OU2 Upland Facility; analysis assumes even distribution across riverbank area.
- Method Source: Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final. April 1998, updated December 2001.
- Acceptable risk level (ARL)[OAR 340-122-115(6)] for populations of ecological receptors is a 10% or less chance that 20% or more of the total local population would receive an exposure greater than the EBV.

Appendix F-6 Calculation Worksheets for Population-level Probabilistic Risk Analyses - Copper (composite samples)

Swan Island OU2 Upland Facility

Analysis of probability of exposure exceeding Acceptable Risk Levels

RECEPTOR: AMERICAN ROBIN - 100% Invertebrate Diet

Exposure Parameters	Value	Unit
IRsoil	0.1515	kg soil/kg food
IRfood	0.207	kg dw/kg bw-d
Pplant	0	fraction
Pearthworm	1	fraction
Soil bioavailability factor	1	unitless

CHEMICAL: **Copper** **Composite samples only**

LOCATION	Concentration of Chemical in Soil		Dose of Chemical	
	Csoil (mg/kg)	ln(Csoil)	Dose (mg/kg BW/day)	ln(dose)
RB-4 Composite	65.90	4.19	9.09	2.21
RB-6 Composite	57.70	4.06	7.96	2.07
RB-7 Composite	71.30	4.27	9.84	2.29
RB-3 Composite	96.30	4.57	13.29	2.59
RB-2 Composite	92.40	4.53	12.75	2.55
RB-5 Composite	33.30	3.51	4.59	1.52
RB-1 Composite	271.00	5.60	37.39	3.62

STATISTICS				
	mg/kg	ln	mg/kg BW/day	ln
Average	98.27	4.39	13.6	2.41
Standard Deviation	79.1	0.64	10.9	0.64
Distribution			log normal	

PROBABILISTIC ANALYSIS - log based calculations				
	Number of animals (n)	49		
EBV (mg/kg/day)	ln(EBV)	Individual Probability of Exp>EBV (p)	Probability that more than 20% of the local population will experience Exp>EBV (b)	where b=1-BINOMDIST(#kills,#trials,prob of kill,cumulative)
4.05	1.40	0.942	1.00	Acceptable Risk Level (ARL) for non T/E Species: probability <0.1
18.5	2.92	0.213	0.61	
20.8	3.03	0.164	0.27	
22.0	3.09	0.143	0.154	
28.7	3.36	0.069	0.00171	
42	3.74	0.019	0.0000000	
68.4	4.23	0.002	0.0000000	

Notes:

- Refer to Table 4-1 for description of all exposure parameters and intake/dose equations.
- Refer to Table 4-2 for description of all ecological benchmark values (EBV).
- Refer to text for description of calculation of number of individuals.
- All locations are within the riverbank area of Swan Island OU2 Upland Facility; analysis assumes even distribution across riverbank area.
- Method Source: Oregon Department of Environmental Quality (DEQ). 2001. Guidance for Ecological Risk Assessment: Levels I, II, III, IV. Waste Management & Cleanup Division, Final. April 1998, updated December 2001.
- Acceptable risk level (ARL)[OAR 340-122-115(6)] for populations of ecological receptors is a 10% or less chance that 20% or more of the total local population would receive an exposure greater than the EBV.

APPENDIX G
Ecological Benchmark Value (EBV) Calculations

Appendix G-1 Ecological Benchmark Value (EBV) Calculations based on Reproduction/ Growth Endpoints - Zinc

Result Number	Reference	Ref No.	Test Organism	Number of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
REPRODUCTION (REP)																		
75	Kaya et al, 2001	48543	Chicken (*Gallus domesticus*)	5	U	FD	12	w	NR	NR	LB	F	REP	PROG	WO	13.8		75
76	Schisler and Kienholz, 1967	8798	Chicken (*Gallus domesticus*)	2	U	FD	14	w	48	w	LB	F	REP	PROG	WO	14.4		70
77	Jensen and Maurice, 1980	9749	Chicken (*Gallus domesticus*)	3	U	FD	6	w	NR	NR	LB	F	REP	PROG	WO	24.7	98.8	82
78	Jackson et al, 1986	6133	Chicken (*Gallus domesticus*)	6	U	FD	140	d	40	w	LB	F	REP	PROG	WO	55	105	81
79	Gibson et al, 1986	6048	Chicken (*Gallus domesticus*)	6	U	FD	10	w	30	w	JV	F	REP	PROG	WO	57.3	66.5	81
80	Stevenson et al, 1987	8184	Chicken (*Gallus domesticus*)	9	U	FD	140	d	28	w	JV	F	REP	PROG	WO	63.9	76.7	81
81	Gibson et al, 1986	6048	Chicken (*Gallus domesticus*)	6	U	FD	10	w	30	w	LB	F	REP	PROG	WO	64.1	123	81
82	Stevenson et al, 1987	8184	Chicken (*Gallus domesticus*)	9	U	FD	140	d	28	w	LB	F	REP	PROG	WO	67.8	84.8	81
83	Stahl, et al, 1990	5764	Chicken (*Gallus domesticus*)	4	U	FD	12	w	56	w	LB	F	REP	PROG	WO	106		71
84	Gasaway and Buss, 1972	9261	Mallard duck (*Anas platyrhynchos*)	4	U	FD	60	d	7	w	JV	M	REP	TEWT	TE			79
85	Jackson et al, 1986	6133	Chicken (*Gallus domesticus*)	5	U	FD	1	w	40	w	SM	F	REP	PROG	WO			75
86	Jensen and Maurice, 1980	9749	Chicken (*Gallus domesticus*)	2	U	FD	6	w	NR	NR	LB	F	REP	PROG	WO			79
87	Stepinska et al, 1987	5770	Chicken (*Gallus domesticus*)	2	U	FD	5	d	71	w	LB	F	REP	PROG	WO	31.2		75
88	Jackson et al, 1986	6133	Chicken (*Gallus domesticus*)	5	U	FD	1	w	40	w	LB	F	REP	PROG	WO	88		75
89	Berry and Brake, 1985	6144	Chicken (*Gallus domesticus*)	2	U	FD	4	d	60	w	LB	F	REP	RHIS	OD	101		73
90	Berry and Brake, 1990	7089	Chicken (*Gallus domesticus*)	2	U	FD	49	d	66	w	LB	F	REP	RHIS	OD	205		73
GROWTH (GRO)																367		
91	Schisler and Kienholz, 1967	8798	Chicken (*Gallus domesticus*)	2	U	FD	14	w	48	w	JV	F	GRO	BDWT	WO	14.4 988		68
92	Baker and Halpin, 1988	5917	Chicken (*Gallus domesticus*)	2	M	FD	14	d	8	d	JV	M	GRO	BDWT	WO	15 988		73
93	Mohanna and Nys, 1999	5090	Chicken (*Gallus domesticus*)	2	U	FD	16	d	5	d	JV	NR	GRO	BDWT	WO	16.1		68
94	Hamilton et al, 1979	6655	Japanese quail (*Coturnix japonica*)	2	U	FD	14	d	0	d	JV	B	GRO	BDWT	WO	21.5		80
95	Hill, 1974	1369	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	B	GRO	BDWT	WO	28.7		76
96	Stahl et al, 1989	5820	Chicken (*Gallus domesticus*)	2	U	FD	20	d	1	d	JV	B	GRO	BDWT	WO	35.4		68
97	Hill, 1990	5734	Chicken (*Gallus domesticus*)	2	U	FD	19	d	1	d	JV	F	GRO	BDWT	WO	36.6		76
98	Hamilton et al, 1981	6403	Japanese quail (*Coturnix japonica*)	3	U	FD	14	d	1	d	JV	B	GRO	BDWT	WO	43.3	86.6	83
99	Jackson et al, 1986	6133	Chicken (*Gallus domesticus*)	6	U	FD	140	d	40	w	SM	F	GRO	BDWT	WO	55	105	79
100	Harland et al, 1975	6887	Japanese quail (*Coturnix japonica*)	2	U	FD	1	w	1	d	JV	B	GRO	BDWT	WO	55.1		77
101	Berg and Martinson, 1972	93	Chicken (*Gallus domesticus*)	7	U	FD	2	w	1	d	JV	NR	GRO	BDWT	WO	55.3	111	78
102	Lefevre et al, 1982	392	Chicken (*Gallus domesticus*)	2	U	FD	5	w	1	d	JV	NR	GRO	BDWT	WO	63.2		76
103	Sandoval et al, 1998	7245	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	70.6	106	84
104	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	M	GRO	BDWT	WO	74.3	111	83
105	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	M	GRO	BDWT	WO	74.7	112	83
106	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	M	GRO	BDWT	WO	75	150	79
107	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	M	GRO	BDWT	WO	75.7	114	83
108	Hill, 1974	92	Chicken (*Gallus domesticus*)	5	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO	85.9	172	82
109	Hamilton et al, 1979	6655	Japanese quail (*Coturnix japonica*)	6	U	FD	14	d	8	d	JV	B	GRO	BDWT	WO	86.8	174	86
110	Henry et al, 1987	6039	Chicken (*Gallus domesticus*)	4	U	FD	1	w	1	d	JV	M	GRO	BDWT	WO	92.3	185	83
111	Gibson et al, 1986	6048	Chicken (*Gallus domesticus*)	6	U	FD	10	w	30	w	JV	F	GRO	BDWT	WO	96.9	145	79
112	Stevenson et al, 1987	8184	Chicken (*Gallus domesticus*)	9	U	FD	140	d	28	w	JV	F	GRO	BDWT	WO	99.1	149	79
113	Sandoval et al, 1999	5067	Chicken (*Gallus domesticus*)	2	U	FD	7	d	14	d	JV	M	GRO	BDWT	WO	103		68
114	Sandoval et al, 1999	5067	Chicken (*Gallus domesticus*)	2	U	FD	7	d	14	d	JV	M	GRO	BDWT	WO	103		68
115	Stahl, et al, 1990	5764	Chicken (*Gallus domesticus*)	3	U	FD	44	w	24	w	LB	F	GRO	BDWT	WO	129		69
116	Stevenson et al, 1987	8184	Chicken (*Gallus domesticus*)	9	U	FD	140	d	28	w	LB	F	GRO	BDWT	WO	129	194	79
117	Bafundo et al, 1984	2517	Chicken (*Gallus domesticus*)	2	U	FD	14	d	8	d	JV	F	GRO	BDWT	WO	142		67
118	Dewar et al, 1983	37018	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO	143	286	79
119	Vohra and Kratzer, 1968	14404	Turkey (*Meleagris gallopavo*)	7	U	FD	21	d	NR	NR	JV	B	GRO	BDWT	WO	148	297	77
120	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	M	GRO	BDWT	WO	155	232	83
121	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	M	GRO	BDWT	WO	158	237	83
122	Southern and Baker, 1983	6368	Chicken (*Gallus domesticus*)	3	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	177	354	83
123	Oh et al, 1979	6627	Chicken (*Gallus domesticus*)	6	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	252	503	79
124	Jackson et al, 1986	6133	Chicken (*Gallus domesticus*)	5	U	FD	1	w	40	w	SM	F	GRO	BDWT	WO	367	480	79
125	Lu and Combs, 1988	5903	Chicken (*Gallus domesticus*)	2	U	FD	15	d	1	d	JV	NR	GRO	BDWT	WO			72
126	Stahl et al, 1989	5820	Chicken (*Gallus domesticus*)	2	U	FD	20	d	1	d	JV	B	GRO	BDWT	WO			77
127	Lu and Combs, 1988	5866	Chicken (*Gallus domesticus*)	2	U	FD	6	d	20	d	JV	NR	GRO	BDWT	WO			73

21.6

31

39

Appendix G-1 Ecological Benchmark Value (EBV) Calculations based on Reproduction/ Growth Endpoints - Zinc

Result Number	Reference	Ref No.	Test Organism	Number of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
128	Lu et al, 1990	8008	Chicken (*Gallus domesticus*)	2	U	FD	7	d	14	d	JV	B	GRO	BDWT	WO			72
129	Jackson et al, 1986	6133	Chicken (*Gallus domesticus*)	5	U	FD	21	d	40	w	SM	F	GRO	BDWT	WO			73
130	Jensen and Maurice, 1980	9749	Chicken (*Gallus domesticus*)	2	U	FD	6	w	NR	NR	SM	F	GRO	BDWT	WO			77
131	Gasaway and Buss, 1972	9261	Mallard duck (*Anas platyrhynchos*)	4	U	FD	10	d	7	w	JV	B	GRO	BDWT	WO	65.7		77
132	Pimentel et al, 1992	5617	Chicken (*Gallus domesticus*)	2	M	FD	3	w	1	d	JV	B	GRO	BDWT	WO	88		77
133	Dewar et al, 1983	37018	Chicken (*Gallus domesticus*)	4	U	FD	4	w	2	w	JV	B	GRO	BDWT	WO	101		72
134	Berg and Martinson, 1972	93	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	NR	GRO	BDWT	WO	126		72
135	Bafundo et al, 1984	6273	Chicken (*Gallus domesticus*)	2	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	132		76
136	Bafundo et al, 1984	2517	Chicken (*Gallus domesticus*)	2	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	143		76
137	Bartov, 1996	5373	Chicken (*Gallus domesticus*)	4	U	FD	2	w	1	w	JV	F	GRO	BDWT	WO	252		73
138	Rama and Planas, 1981	6435	Chicken (*Gallus domesticus*)	2	U	FD	9	w	1	d	JV	NR	GRO	BDWT	WO	190		70
139	Dean et al, 1991	5681	Chicken (*Gallus domesticus*)	2	M	FD	1	w	1	d	JV	M	GRO	BDWT	WO	284		78
140	Bartov et al, 1994	7956	Chicken (*Gallus domesticus*)	3	U	FD	2	w	1	w	JV	F	GRO	BDWT	WO	315		73
141	Palafox and Ho-A, 1980	6545	Chicken (*Gallus domesticus*)	2	U	FD	5	d	38	w	JV	F	GRO	BDWT	WO	433		71
142	Bartov, 1996	5373	Chicken (*Gallus domesticus*)	4	U	FD	2	w	1	w	JV	F	GRO	BDWT	WO	757	1370	73
																914		

Studies with an exposure duration equal to or greater than 10 weeks (70 days)

	AVERAGE	[illegible]	116.6
Studies with an ED >= 10 weeks	GEOMEAN	55.026	110.5111
	COUNT	14	9
All Studies	AVERAGE	87.0674	266.8635
	GEOMEAN	66.0659	171.4392
	COUNT	43	52

Source

Ecological Soil Screening Levels for Zinc. Table 5-1: Pg 11-12. Interim Final. OSWER Directive 9285.7-73. US Environmental Protection Agency. June 2007.

Appendix G-2 Ecological Benchmark Value (EBV) Calculations based on a Mortality Endpoint - Zinc

Result Number	Reference	Ref No.	Test Organism	Number of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
SURVIVAL (MOR)																		
143	Hamilton et al, 1979	6655	Japanese quail (*Coturnix japonica*)	2	U	FD	14	d	0	d	JV	B	MOR	MORT	WO	21.5		81
144	Stahl et al, 1989	5820	Chicken (*Gallus domesticus*)	2	U	FD	20	d	1	d	JV	B	MOR	MORT	WO	31		78
145	Stahl et al, 1989	5820	Chicken (*Gallus domesticus*)	2	U	FD	20	d	1	d	JV	B	MOR	MORT	WO	35.4		78
146	Harland et al, 1975	6887	Japanese quail (*Coturnix japonica)*	2	U	FD	1	w	1	d	JV	B	MOR	MORT	WO	55.1		78
147	Lefevre et al, 1982	392	Chicken (*Gallus domesticus*)	2	U	FD	5	w	1	d	JV	NR	MOR	MORT	WO	63.2		79
148	Gibson et al, 1986	6048	Chicken (*Gallus domesticus*)	6	U	FD	10	w	30	w	JV	F	MOR	MORT	WO	68.8	87.1	80
149	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	10	U	FD	4	w	1	w	JV	M	MOR	SURV	WO	75.6		73
150	Hamilton et al, 1981	6403	Japanese quail (*Coturnix japonica*)	3	U	FD	14	d	1	d	JV	B	MOR	MORT	WO	89.5		78
151	Blalock and Hill, 1988	5868	Chicken (*Gallus domesticus*)	3	U	FD	12	d	1	d	JV	F	MOR	MORT	WO	109	219	79
152	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	M	MOR	SURV	WO	115		78
153	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	M	MOR	SURV	WO	120		77
154	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	M	MOR	SURV	WO	121		78
155	Dewar et al, 1983	37018	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	B	MOR	MORT	WO	143	286	80
156	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	M	MOR	SURV	WO	159	239	84
157	Hill, 1974	92	Chicken (*Gallus domesticus*)	5	U	FD	5	w	1	d	JV	B	MOR	MORT	WO	172		68
158	Hamilton et al, 1979	6655	Japanese quail (*Coturnix japonica*)	6	U	FD	14	d	0	d	JV	B	MOR	MORT	WO	183	366	87
159	Oh et al, 1979	6627	Chicken (*Gallus domesticus*)	6	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	252	503	80
160	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	M	MOR	SURV	WO	255		78
161	Roberson and Schaible, 1960	14538	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	M	MOR	SURV	WO	272		78
162	Dewar et al, 1983	37018	Chicken (*Gallus domesticus*)	3	U	FD	4	d	18	mo	AD	F	MOR	MORT	WO	319		69
163	Hill, 1974	1369	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	B	MOR	MORT	WO	320		77
164	Dewar et al, 1983	37018	Chicken (*Gallus domesticus*)	4	U	FD	4	w	2	w	JV	B	MOR	MORT	WO	327	491	79
165	Vohra and Kratzer, 1968	14404	Turke y (*Meleagris gallopavo*)	7	U	FD	21	d	NR	NR	JV	B	MOR	MORT	WO	741		72
166	Gasawa y and Buss, 1972	9261	Mallard duck (*Anas platyrhynchos*)	4	U	FD	30	d	7	w	JV	B	MOR	MORT	WO			78
167	Van Vleet et al, 1981	80	Duck (*Anas platyrhynchos*)	2	U	FD	15	d	1	d	JV	M	MOR	MORT	WO			77
168	Van Vleet et al, 1981	80	Duck (*Anas platyrhynchos*)	2	U	FD	15	d	1	d	JV	M	MOR	MORT	WO			77

Studies with an exposure duration equal to or greater than 4 weeks (28 days)

126 401 893

		NOAEL	LOAEL
All Values	AVERAGE	176.004	352.11
	GEOMEAN	126.312	293.737
	COUNT	23	10
Bounded Values	AVERAGE	--	313.014
	GEOMEAN	--	274.641
	COUNT	--	7
Studies with an ED>= 4 weeks	AVERAGE	164.892	321.22
	GEOMEAN	144.77	271.323
	COUNT	13	5

Source

Ecological Soil Screening Levels for Zinc. Table 5-1: Pg. 12. Interim Final. OSWER Directive 9285.7-73. US Environmental Protection Agency. June 2007.

Appendix G-3 Ecological Benchmark Value (EBV) Calculations based on a Reproduction/ Growth Endpoint - Lead

Result Number	Reference	Ref No.	Test Organism	Number of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
REPRODUCTION																		
50	Edens and Garlich, 1983	2608	Japanese quail (Coturnix japonica)	4	U	FD	5	w	6	w	LB	F	REP	PROG	WO	0.194	1.94	77
51	Edens and Garlich, 1983	2608	Chicken (Gallus domesticus)	3	U	FD	4	w	NR	NR	LB	F	REP	PROG	WO	1.63	3.26	79
52	Meluzzi et al., 1996	2771	Chicken (Gallus domesticus)	4	U	FD	30	d	22	w	LB	F	EGG	ALWT	EG	2.69	4.04	81
53	Haegele et al. 1974	2668	Mallard (Anas platyrhynchos)	2	U	FD	76	d	NR	NR	SM	F	EGG	ESTH	EG	5.63		71
54	Pattec 1984	2809	American kestrel (Falco sparverius)	3	M	FD	6	mo	1-6	yr	AD	F	REP	RSUC	WO	12		90
55	Morgan et al., 1975	2779	Japanese quail (Coturnix japonica)	5	U	FD	5	w	6	d	JV	M	REP	TEWT	TE	12.6	126	78
56	Morgan et al., 1975	2779	Japanese quail (Coturnix japonica)	5	U	FD	5	w	1	d	JV	M	REP	TEWT	TE	67.4	135	80
57	Stone and Soares, 1976	2898	Japanese quail (Coturnix japonica)	3	U	FD	32	d	NR	NR	AD	F	REP	PROG	WO	125		67
58	Edens et al., 1976	2606	Japanese quail (Coturnix japonica)	5	U	FD	12	w	0	d	LB	B	REP	EGPN	EG		0.11	77
59	Edens and Garlich, 1983	2608	Japanese quail (Coturnix japonica)	4	U	FD	12	w	NR	NR	LB	F	REP	PROG	WO		0.194	75
60	Edens and Garlich, 1983	2608	Chicken (Gallus domesticus)	5	U	FD	10	w	NR	NR	LB	F	REP	PROG	WO		3.26	75
61	Kendall and Scanlon, 1981	2734	Ringed Turtle Dove (Streptopelia risoria)	2	U	DR	11	w	NR	NR	AD	M	REP	TEWT	TE		11.8	68
62	Edens and Melvin, 1989	2609	Japanese quail (Coturnix japonica)	2	U	FD	1	w	14	w	JV	F	REP	TPRD	WO		93.1	75
63	Stone and Soares, 1976	2898	Japanese quail (Coturnix japonica)	2	U	FD	27	d	NR	NR	AD	F	REP	PROG	WO		377	74
GROWTH																		
64	Edens and Garlich, 1983	2608	Japanese quail (Coturnix japonica)	3	U	FD	5	w	1	d	JV	F	GRO	BDWT	WO	1.56	15.6	77
65	Stone and Fox, 1984	6291	Japanese quail (Coturnix japonica)	3	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO	2.77		72
66	Stone et al., 1977	2897	Japanese quail (Coturnix japonica)	2	U	FD	2	w	1	d	JV	NR	GRO	BDWT	WO	4.64		70
67	Edens and Melvin, 1989	2609	Japanese quail (Coturnix japonica)	3	U	FD	4	w	0	d	JV	F	GRO	BDWT	WO	5.93	59.3	76
68	Damron et al, 1969	14768	Chicken (Gallus domesticus)	4	U	FD	4	w	4	w	JV	NR	GRO	BDWT	WO	6.14	61.4	76
69	Damron et al, 1969	14768	Chicken (Gallus domesticus)	4	U	FD	4	w	4	w	JV	NR	GRO	BDWT	WO	7.1	71	76
70	Edens et al., 1976	2606	Japanese quail (Coturnix japonica)	5	U	FD	12	w	0	d	JV	F	GRO	BDWT	WO	11.1	111	79
71	Edens, 1985	2605	Japanese quail (Coturnix japonica)	5	U	FD	12	w	1	w	JV	F	GRO	BDWT	WO	11.2	112	76
72	Morgan et al., 1975	2779	Japanese quail (Coturnix japonica)	5	U	FD	2	w	6	d	JV	NR	GRO	BDWT	WO	12.6	126	76
73	Morgan et al., 1975	2779	Japanese quail (Coturnix japonica)	5	U	FD	1	w	1	d	JV	NR	GRO	BDWT	WO	13.5	67.4	76
74	Howell and Hill, 1978	1387	Chicken (Gallus domesticus)	2	U	FD	21	d	1	d	JV	B	GRO	BDWT	WO	14.2		67
75	Jeng et. al. 1979	2718	Duck (Anas platyrhynchos)	3	U	GV	3	mo	24	w	MA	F	GRO	BDWT	WO	20		87
76	Hoffman et al., 1985	2696	American kestrel (Falco sparverius)	4	U	GV	10	d	1	d	JV	NR	GRO	BDWT	WO	25	125	88
77	Howell and Hill, 1978	1387	Chicken (Gallus domesticus)	2	U	FD	20	d	1	d	JV	B	GRO	BDWT	WO	28.4		67
78	Stone et al., 1981	6463	Japanese quail (Coturnix japonica)	5	U	FD	14	d	1	d	JV	B	GRO	BDWT	WO	34.5		77
79	Custer et al., 1984	2581	American kestrel (Falco sparverius)	4	M	FD	60	d	1-2	yr	AD	B	GRO	BDWT	WO	54.3		68
80	Berg et al., 1980	2534	Chicken (Gallus domesticus)	5	U	FD	2	w	1	d	JV	M	GRO	BDWT	WO	61.3	123	83
81	Frederick, 1976	2638	Mallard (Anas platyrhynchos)	4	U	FD	8	d	9	d	JV	NR	GRO	BDWT	WO	66.9		67
82	Donaldson and McGowan, 1989	1285	Chicken (Gallus domesticus)	5	U	FD	20	d	1	d	JV	M	GRO	BDWT	WO		38.2	72
83	Latta and Donaldson, 1986	2744	Chicken (Gallus domesticus)	2	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO		53.1	71
84	Stone and Soares, 1976	2898	Japanese quail (Coturnix japonica)	3	U	FD	32	d	NR	NR	AD	F	GRO	BDWT	WO		64.3	72
85	Leeming and Donaldson, 1984	2748	Chicken (Gallus domesticus)	2	U	FD	19	d	1	d	JV	M	GRO	BDWT	WO		76.3	71
86	Berg et al., 1980	2534	Chicken (Gallus domesticus)	3	U	FD	2	w	1	d	JV	M	GRO	BDWT	WO		124	77
87	Bafundo et al. 1984	2517	Chicken (Gallus domesticus)	4	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO		152	71
88	Donaldson, 1986	2600	Chicken (Gallus domesticus)	2	U	FD	20	d	1	d	JV	M	GRO	BDWT	WO		163	72
89	Khan, et al, 1993	5507	Chicken (Gallus domesticus)	2	U	OR	4	w	NR	NR	JV	B	GRO	BDWT	WO		200	74
90	Cupo and Donaldson, 1987	2579	Chicken (Gallus domesticus)	2	U	FD	7	d	1	d	JV	M	GRO	BDWT	WO		262	72
91	Berg et al., 1980	2534	Chicken (Gallus domesticus)	2	U	FD	2	w	1	d	JV	M	GRO	BDWT	WO		270	77
92	Franson and Custer, 1982	2635	Chicken (Gallus domesticus)	2	U	FD	7	d	1	d	IM	NR	GRO	BDWT	WO		273	72
93	Bafundo et al. 1984	2517	Chicken (Gallus domesticus)	2	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO		282	71

Studies with an exposure duration equal to or greater than 10 weeks (70 days)

		NOAEL	LOAEL
Studies >=10 wks-Food only	AVERAGE	9.9825	45.3128
	GEOMEAN	9.57321	3.86715
	COUNT	4	5
All Values (including all durations, gavage/food/water, etc.)	AVERAGE	23.3955	108.646
	GEOMEAN	10.9408	44.6252
	COUNT	26	33

Source

Ecological Soil Screening Levels for Lead. Table 5-1: Pg 7-8. Interim Final. OSWER Directive 9285.7-70. US Environmental Protection Agency. March 2005.

Appendix G-4 Ecological Benchmark Value (EBV) Calculations based on a Mortality Endpoint - Lead

Result Number	Reference	Ref No.	Test Organism	Number of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
SURVIVAL (MOR)																		
94	Finley et al., 1976	2624	Mallard (Anas platyrhynchos)	4	M	FD	12	w	1	yr	AD	M	MOR	MORT	WO	2.47		80
95	Barthalmus et al., 1977	2526	Pigeon (Columba livia)	4	U	GV	40	d	NR	NR	AD	M	MOR	MORT	WO	12.5	25	82
96	Howell and Hill, 1978	1387	Chicken (Gallus domesticus)	2	U	FD	21	d	1	d	JV	B	MOR	MORT	WO	14.2		77
97	Howell and Hill, 1978	1387	Chicken (Gallus domesticus)	2	U	FD	20	d	1	d	JV	B	MOR	MORT	WO	28.4		77
98	Custer et al., 1984	2581	American kestrel (Falco sparverius)	4	M	FD	60	d	1-2	yr	AD	B	MOR	MORT	WO	54.3		78
99	Frederick, 1976	2638	Mallard (Anas platyrhynchos)	4	U	FD	8	d	9	d	JV	NR	MOR	MORT	WO	66.9		77
100	Hoffman et al., 1985	2696	American kestrel (Falco sparverius)	4	U	GV	10	d	1	d	JV	NR	MOR	SURV	WO	125	625	89
101	Vengris and Mare, 1974	14384	Chicken (Gallus domesticus)	7	U	GV	35	d	6	w	JV	B	MOR	MORT	WO	160	320	86
102	Donaldson and McGowan, 1989	1285	Chicken (Gallus domesticus)	5	U	FD	20	d	1	d	JV	M	MOR	MORT	WO	163		66
103	Johnsen and Damron 1982	2724	Goose (Anser cygnides)	5	U	FD	12	w	26	w	JV	NR	MOR	MORT	WO	196		73
104	Anders et al., 1982	2513	Pigeon (Columba livia)	2	U	GV	4	w	NR	NR	AD	M	MOR	MORT	WO			73
105	Cupo and Donaldson, 1987	2579	Chicken (Gallus domesticus)	2	U	FD	21	d	1	d	JV	M	MOR	MORT	WO			73
106	Khan et al, 1993	1415	Chicken (Gallus domesticus)	2	U	GV	7	d	43	d	JV	F	MOR	MORT	WO		400	80

		6.25	
Studies >=10 wks-Food only	AVERAGE	99.235	NA
	GEOMEAN	22.00273	NA
	COUNT	2	NA

Studies with an exposure duration equal to or greater than 10 weeks (70 days)

Source

Ecological Soil Screening Levels for Lead. Table 5-1: Pg 8. Interim Final. OSWER Directive 9285.7-70. US Environmental Protection Agency. March 2005.

Appendix G-5 Ecological Benchmark Value (EBV) Calculations based on Reproduction/ Growth Endpoints - Copper

Result Number	Reference	Ref. No.	Test Organism	Number Conc/ Doses	Method of Analysis	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
Reproduction (REP)																		
189	Ankari et al, 1998	2006	Chicken (*Gallus domesticus*)	4	U	FD	84	d	25	w	LB	F	REP	EGPN	WO	4.05	12.1	80
190	Harms and Buresh, 1986	2117	Chicken (*Gallus domesticus*)	3	U	FD	6	w	64	w	LB	F	REP	EGPN	WO	13.9	19.5	85
191	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	LB	F	EGG	EGWT	EG	15.6	23.3	86
192	Stevenson et al, 1983	6170	Chicken (*Gallus domesticus*)	4	U	GV	5	d	27	w	LB	F	REP	PROG	WO	16.7	34.0	89
193	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	LB	F	REP	EGPN	WO	17.0	25.5	86
194	Stevenson et al, 1983	6170	Chicken (*Gallus domesticus*)	4	U	FD	5	d	27	w	LB	F	REP	PROG	WO	18.0	28.0	86
195	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	LB	F	EGG	EGWT	EG	19.4	29.0	86
196	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	LB	F	REP	EGPN	WO	20.5	30.7	86
197	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	336	d	17	w	LB	F	REP	EGPN	WO	21.6		71
198	Griminger, 1977	2112	Chicken (*Gallus domesticus*)	5	U	FD	2	w	7	mo	LB	F	EGG	ESTH	EG	22.4	44.8	85
199	Pearce et al, 1983	2294	Chicken (*Gallus domesticus*)	5	U	FD	12	d	26	w	LB	F	REP	EGPN	WO	22.5	45.0	85
200	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	232	d	17	w	LB	F	REP	EGPN	WO	23.2	29.9	86
201	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	LB	F	REP	EGPN	WO	23.9		76
202	Stevenson and Jackson, 1980	2292	Chicken (*Gallus domesticus*)	5	U	FD	6	d	24	w	LB	F	REP	EGPN	WO	27.2	54.4	85
203	Chiou et al, 1997	2050	Chicken (*Gallus domesticus*)	5	M	FD	4	w	28	w	LB	F	REP	EGPN	WO	27.5	40.6	91
204	Jackson, 1977	2157	Chicken (*Gallus domesticus*)	6	U	FD	35	d	NR	NR	LB	F	REP	PROG	WO	29.1	47.5	86
205	Jackson and Stevenson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	LB	F	REP	EGPN	WO	30.4		76
206	Chiou et al, 1998	2049	Chicken (*Gallus domesticus*)	4	U	FD	4	w	38	w	LB	F	REP	EGPN	WO	33.4	40.1	86
207	Jackson and Stevenson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	LB	F	REP	EGPN	WO	35.2		76
208	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	LB	F	REP	ORWT	OV	40.0	50.0	86
209	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	LB	F	REP	EGPN	WO	43.3		71
210	Shivanandappa et al, 1983	3727	Chicken (*Gallus domesticus*)	6	U	OR	3	w	25	w	JV	M	REP	SPCV	TE	239	318	87
211	Kadirvel and Kothandaraman,	11876	Chicken (*Gallus domesticus*)	2	U	FD	28	w	12	w	LB	F	EGG	EGWT	WO		19.7	80
212	Stevenson and Jackson, 1980	2293	Chicken (*Gallus domesticus*)	4	U	FD	8	w	24	w	LB	F	REP	EGPN	WO		22.6	79
213	Shivanandappa et al, 1983	3727	Chicken (*Gallus domesticus*)	5	U	OR	3	w	25	w	JV	M	REP	SPCV	TE		536	81
Growth (GRO)																		
214	Hoda and Maha, 1995	2007	Chicken (*Gallus domesticus*)	3	U	FD	6	w	1	d	JV	M	GRO	BDWT	WO	1.92		78
215	Kashani et al, 1986	2171	Turkey (*Melagris gallopavo*)	4	U	FD	8	w	1	d	JV	M	GRO	BDWT	WO	2.34	4.68	83
216	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	2.70		76
217	Hill, 1974	1369	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO	2.75		76
218	Guenthner et al, 1978	2114	Turkey (*Melagris gallopavo*)	2	U	FD	24	w	1	d	JV	M	GRO	BDWT	WO	2.97		68
219	McGhee et al, 1965	14453	Chicken (*Gallus domesticus*)	5	U	FD	4	w	NR	NR	JV	NR	GRO	BDWT	WO	3.83	7.67	83
220	King, 1975	2177	Duck (*Anas platyrhynchos*)	2	U	FD	56	d	8	d	JV	B	GRO	BDWT	WO	4.15		76
221	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	4.43		76
222	King, 1972	2178	Chicken (*Gallus domesticus*)	2	U	FD	9	w	1	d	JV	B	GRO	BDWT	WO	4.65		67
223	Kayongo-Male and Palmer,	5149	Turkey (*Melagris gallopavo*)	3	U	FD	4	w	NR	NR	JV	NR	GRO	BDWT	WO	4.75		68
224	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	5.43		76
225	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	3	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	5.56		76
226	Waibel et al, 1964	14405	Turkey (*Melagris gallopavo*)	3	U	FD	3	w	7	d	JV	NR	GRO	BDWT	WO	5.82	46.6	75
227	Hoda and Maha, 1995	2007	Chicken (*Gallus domesticus*)	3	U	FD	6	w	1	d	JV	NR	GRO	BDWT	WO	6.28		78
228	Hoda and Maha, 1995	2007	Chicken (*Gallus domesticus*)	3	U	FD	6	w	1	d	JV	NR	GRO	BDWT	WO	7.55		78
229	Hill, 1974	92	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	B	GRO	BDWT	WI	7.63		76
230	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	8.19		76
231	Ko et al, 1985	2181	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	d	JV	M	GRO	BDWT	WO	8.40		69
232	Ekperigin and Vohra, 1981	6474	Chicken (*Gallus domesticus*)	4	U	FD	7	d	6	d	JV	NR	GRO	BDWT	WO	8.59	42.9	80
233	Ekperigin and Vohra, 1981	6474	Chicken (*Gallus domesticus*)	3	U	FD	7	d	7	d	JV	NR	GRO	BDWT	WO	8.59	42.9	80
234	Gill et al, 1995	2107	Chicken (*Gallus domesticus*)	4	U	FD	3	w	4	w	JV	M	GRO	BDWT	WO	9.52	19.0	84
235	Skrivan et al, 2000	25969	Chicken (*Gallus domesticus*)	2	M	FD	38	d	1	d	JV	B	GRO	BDWT	WO	9.72		82
236	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	5	M	DR	14	d	4	d	JV	NR	GRO	BDWT	WO	10.2	51.6	82
237	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	3	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	11.1		76
238	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	2	U	FD	42	d	21	d	JV	M	GRO	BDWT	WO	11.5		67
239	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	5	U	FD	35	d	1	d	JV	M	GRO	BDWT	WO	11.9		76
240	Nam et al, 1984	2226	Chicken (*Gallus domesticus*)	3	U	FD	4	w	3	d	JV	NR	GRO	BDWT	WO	12.2	24.3	83
241	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	DR	14	d	4	d	JV	NR	GRO	BDWT	WO	12.6		78

Appendix G-5 Ecological Benchmark Value (EBV) Calculations based on Reproduction/ Growth Endpoints - Copper

Result Number	Reference	Ref. No.	Test Organism	Number Conc/ Doses	Method of Analysis	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
242	Chiou et al, 1999	2048	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	w	JV	NR	GRO	BDWT	WO	13.3	26.6	84
243	Jenkins et al, 1970	2162	Chicken (*Gallus domesticus*)	2	M	FD	6	w	1	d	JV	B	GRO	BDWT	WO	13.4		73
244	Marron et al, 2001	25968	Chicken (*Gallus domesticus*)	2	U	FD	21	d	7	d	JV	M	GRO	BDWT	WO	14.2		68
245	Hill, 1990	5734	Chicken (*Gallus domesticus*)	5	U	FD	19	d	1	d	JV	F	GRO	BDWT	WO	14.2		76
246	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3	28.7	82
247	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	5	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3	28.7	82
248	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3	28.7	82
249	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	5	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3	28.7	82
250	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3	28.7	82
251	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3		67
252	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	14.3		67
253	Bakalli et al, 1995	3717	Chicken (*Gallus domesticus*)	2	U	FD	41	d	1	d	JV	M	GRO	BDWT	WO	14.3		76
254	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	3	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	15.7	25.8	84
255	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	B	GRO	BDWT	WO	16.5	24.7	84
256	Stevenson and Jackson, 1980	2292	Chicken (*Gallus domesticus*)	5	U	FD	6	d	24	w	SM	F	GRO	BDWT	WO	16.7	33.4	83
257	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	B	GRO	BDWT	WO	17.2	25.8	84
258	Pesti and Bakalli, 1996	2244	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	M	GRO	BDWT	WO	17.5		76
259	Smith, 1969	2284	Chicken (*Gallus domesticus*)	4	U	FD	25	d	1	d	JV	M	GRO	BDWT	WO	17.8	31.1	83
260	Wang et al,1987	2319	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	17.8	35.5	82
261	Stevenson et al, 1983	6170	Chicken (*Gallus domesticus*)	4	U	FD	5	d	27	w	SM	F	GRO	BDWT	WO	18.0	28.0	80
262	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	NR	GRO	BDWT	WO	18.2		68
263	Ward et al, 1995	6788	Turkey (*Melagris gallopavo*)	2	M	FD	10	d	5	d	JV	M	GRO	BDWT	WO	18.3		74
264	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	NR	GRO	BDWT	WO	18.3		68
265	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	NR	GRO	BDWT	WO	18.4		68
266	Jensen and Maurice, 1978	2166	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	18.5	37.1	83
267	Jensen and Maurice, 1978	2164	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	NR	GRO	BDWT	WO	18.6		68
268	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	5	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	19.6	30.5	84
269	Kadirvel and Kothandaraman,	11876	Chicken (*Gallus domesticus*)	2	U	FD	28	w	12	w	SM	F	GRO	BDWT	WO	19.7		69
270	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	GRO	BDWT	WO	20.5	30.7	84
271	Pimentel et al, 1992	5617	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	B	GRO	BDWT	WO	20.9		68
272	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	3	U	FD	14	d	8	d	JV	NR	GRO	BDWT	WO	21.3	42.7	83
273	Ekperigin and Vohra, 1981	6474	Chicken (*Gallus domesticus*)	5	U	FD	7	d	9	d	JV	NR	GRO	BDWT	WO	21.5	42.9	82
274	Ekperigin and Vohra, 1981	6474	Chicken (*Gallus domesticus*)	2	U	FD	8	d	9	d	JV	NR	GRO	BDWT	WO	21.5		76
275	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	336	d	17	w	SM	F	GRO	BDWT	WO	21.6		68
276	Wideman et al, 1996	2325	Chicken (*Gallus domesticus*)	5	M	FD	2	w	1	d	JV	M	GRO	BDWT	WO	21.7		76
277	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	M	FD	21	d	1	d	JV	B	GRO	BDWT	WO	21.9	34.0	89
278	Griminger, 1977	2112	Chicken (*Gallus domesticus*)	5	U	FD	2	w	7	mo	SM	F	GRO	BDWT	WO	22.4	44.8	83
279	Kassim and Suwanpradit, 1996	2172	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	22.7	34.1	83
280	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	GRO	BDWT	WO	23.0	30.7	84
281	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	232	d	17	w	SM	F	GRO	BDWT	WO	23.2	29.9	84
282	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	GRO	BDWT	WO	23.3	31.0	84
283	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	GRO	BDWT	WO	23.9		74
284	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	24.7		67
285	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	GRO	BDWT	WO	26.4	35.2	84
286	Ward et al, 1995	6788	Turkey (*Melagris gallopavo*)	2	M	DR	10	d	5	d	JV	M	GRO	BDWT	WO	26.6		69
287	Ledoux et al, 1989	5812	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	26.9	40.4	78
288	Chiou et al, 1997	2050	Chicken (*Gallus domesticus*)	5	M	FD	28	d	28	w	SM	F	GRO	BDWT	WO	27.9	35.3	89
289	Hill, 1989	7091	Chicken (*Gallus domesticus*)	4	U	FD	19	d	NR	NR	JV	NR	GRO	BDWT	WO	28.4		70
290	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	28.7	57.4	82
291	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	28.7		67
292	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	M	FD	21	d	1	d	JV	B	GRO	BDWT	WO	29.5		83
293	Vohra and Kratzer, 1968	14404	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	NR	NR	JV	B	GRO	BDWT	WO	29.7	59.3	82
294	Hill, 1990	5734	Chicken (*Gallus domesticus*)	4	U	FD	19	d	1	d	JV	F	GRO	BDWT	WO	30.4		76
295	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	GRO	BDWT	WO	30.7		74
296	Mehring and Brumbaugh, 1960	22	Chicken (*Gallus domesticus*)	5	M	FD	10	w	1	d	JV	B	GRO	BDWT	WO	33.0	43.3	88

Appendix G-5 Ecological Benchmark Value (EBV) Calculations based on Reproduction/ Growth Endpoints - Copper

Result Number	Reference	Ref. No.	Test Organism	Number Conc/ Doses	Method of Analysis	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
297	Jensen et al, 1991	2163	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	34.1		68
298	Harms and Buresh, 1986	2118	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	1	d	JV	B	GRO	BDWT	WO	34.6	51.9	84
299	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	5	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	35.2	63.9	83
300	Bafundo et al, 1984	2517	Chicken (*Gallus domesticus*)	2	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	35.5		67
301	Hill, 1990	5734	Chicken (*Gallus domesticus*)	2	U	FD	19	d	1	d	JV	F	GRO	BDWT	WO	35.5		76
302	Funk and Baker, 1991	2099	Chicken (*Gallus domesticus*)	3	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	36.3		78
303	Jensen and Maurice, 1979	2166	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO	36.6		77
304	Davis et al, 1996	1278	Chicken (*Gallus domesticus*)	2	U	FD	21	d	14	d	JV	M	GRO	BDWT	WO	37.1		69
305	Chiou et al, 1998	2049	Chicken (*Gallus domesticus*)	4	U	FD	4	w	38	w	SM	F	GRO	BDWT	WO	40.1		69
306	Southern and Baker, 1983	6368	Chicken (*Gallus domesticus*)	2	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO	41.0		68
307	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	GRO	BDWT	WO	43.3		69
308	Kassim and Suwanpradit, 1996	2172	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	w	JV	M	GRO	BDWT	WO	49.5	74.2	83
309	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	GRO	BDWT	WO	50.0		69
310	Vohra and Kratzer, 1968	14404	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	NR	NR	JV	B	GRO	BDWT	WO	50.1		76
311	Jackson, 1977	2157	Chicken (*Gallus domesticus*)	6	U	FD	35	d	1	yr	SM	F	GRO	BDWT	WO	50.9	55.9	84
312	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	4	M	FD	35	d	3	d	JV	NR	GRO	BDWT	WO	56.8	109	89
313	Vohra and Kratzer, 1968	14404	Turkey (*Melagris gallopavo*)	5	U	FD	21	d	NR	NR	JV	B	GRO	BDWT	WO	60.0	120	82
314	Stevenson et al, 1983	6170	Chicken (*Gallus domesticus*)	4	U	GV	5	d	27	w	SM	F	GRO	BDWT	WO	65.4		68
315	Yannakopoulos et al., 1990	2333	Japanese quail (*Coturnix*	4	U	FD	34	d	7	d	JV	B	GRO	BDWT	WO	82.0		78
316	Leeson and Summers, 1982	2196	Chicken (*Gallus domesticus*)	4	U	FD	21	d	1	d	JV	M	GRO	BDWT	WO	103		68
317	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	FD	35	d	3	d	JV	NR	GRO	BDWT	WO	143		78
318	Ko et al, 1985	2181	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	d	JV	M	GRO	BDWT	WO		2.69	78
319	Kashani et al, 1986	2171	Turkey (*Melagris gallopavo*)	2	U	FD	8	w	1	d	JV	M	GRO	BDWT	WO		4.88	77
320	Harms and Eberst, 1974	9234	Turkey (*Melagris gallopavo*)	2	U	FD	3	w	1	d	JV	NR	GRO	GGRO	WO		10.3	77
321	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO		14.3	76
322	Jensen and Maurice, 1978	2165	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO		17.5	77
323	Latymer and Coates, 1981	2191	Chicken (*Gallus domesticus*)	2	U	FD	24	d	1	d	JV	B	GRO	BDWT	WO		21.3	77
324	Stevenson and Jackson, 1980	2293	Chicken (*Gallus domesticus*)	4	U	FD	8	w	24	w	SM	F	GRO	BDWT	WO		22.6	77
325	Ledoux et al, 1987	2194	Chicken (*Gallus domesticus*)	3	UX	FD	21	d	1	d	JV	F	GRO	BDWT	WO		22.7	82
326	Robbins and Baker, 1980	2266	Chicken (*Gallus domesticus*)	3	U	FD	8	d	8	d	JV	M	GRO	BDWT	WO		26.4	77
327	Robbins and Baker, 1980	2266	Chicken (*Gallus domesticus*)	3	U	FD	8	d	8	d	JV	M	GRO	BDWT	WO		26.4	77
328	Hill, 1974	1369	Chicken (*Gallus domesticus*)	2	U	FD	5	w	1	d	JV	B	GRO	BDWT	WO		28.7	76
329	Christmas and Harms, 1979	2052	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	1	d	JV	B	GRO	BDWT	WO		31.4	78
330	Jensen and Maurice, 1978	2165	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	GRO	BDWT	WO		34.9	77
331	Stevenson and Jackson, 1981	2291	Chicken (*Gallus domesticus*)	2	M	FD	6	w	24	w	SM	F	GRO	BDWT	WO		35.2	83
332	Ekperigin and Vohra, 1981	2084	Chicken (*Gallus domesticus*)	3	U	FD	1	w	12	d	JV	B	GRO	BDWT	WO		35.5	76
333	Wang et al, 1987	2319	Chicken (*Gallus domesticus*)	2	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO		35.5	76
334	Hill, 1974	92	Chicken (*Gallus domesticus*)	6	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO		42.9	76
335	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	2	U	FD	12	d	8	d	JV	NR	GRO	BDWT	WO		50.1	77
336	Robbins and Baker, 1980	2266	Chicken (*Gallus domesticus*)	2	U	FD	8	d	8	d	JV	M	GRO	BDWT	WO		55.2	77
337	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	2	U	FD	8	d	8	d	JV	NR	GRO	BDWT	WO		57.2	77
338	Robbins and Baker, 1980	2267	Chicken (*Gallus domesticus*)	2	U	FD	12	d	8	d	JV	NR	GRO	BDWT	WO		59.0	77
339	Vohra and Kratzer, 1968	14404	Turkey (*Melagris gallopavo*)	4	U	FD	21	d	NR	NR	JV	B	GRO	BDWT	WO		60.0	76
340	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	FD	35	d	3	d	JV	NR	GRO	BDWT	WO		75.5	83
341	Hill, 1979	1370	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	NR	GRO	BDWT	WO		85.9	76
342	Jensen, 1975	1403	Chicken (*Gallus domesticus*)	2	U	FD	14	d	1	d	JV	NR	GRO	BDWT	WO		92.9	78
343	Hill, 1980	395	Chicken (*Gallus domesticus*)	2	U	FD	1	w	1	d	JV	F	GRO	BDWT	WO		138	70

Studies with an exposure duration equal to or greater than 10 weeks (70 days)

		NOAEL	LOAEL
All Studies	AVERAGE	25.37	47.62
	GEOMEAN	18.4943	34.8707
	COUNT	126	90
ED>= 10 weeks	AVERAGE	24.58	30.07
	GEOMEAN	20.7794	28.6496
	COUNT	20	14

Source

Ecological Soil Screening Levels for Copper. Table 5-1: Pg 13-15. Interim Final. OSWER Directive 9285.7-68. US Environmental Protection Agency. February 2007.

Appendix G-6 Ecological Benchmark Value (EBV) Calculations based on a Mortality Endpoint - Copper

Result Number	Reference	Ref. No.	Test Organism	Numbe r Conc/ Doses	Method of Analysis	Route of Exposur e	Exposure Duration	Duratio n Units	Age	Age Units	Lifestag e	Sex	Effect Type	Effect Measur e	Respons e Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
Survival (MOR)																		
344	Hill, 1974	1369	Chicken (*Gallus domesticus*)	2	U	FD	2	w	NR	NR	JV	B	MOR	MORT	WO	2.75		70
345	Wood and Worden, 1973	36216	Chicken (*Gallus domesticus*)	2	U	FD	49	d	2	d	JV	B	MOR	MORT	WO	3.55		77
346	Wood and Worden, 1973	36216	Duck (*Anas platyrhynchos*)	2	U	FD	49	d	2	d	JV	B	MOR	MORT	WO	6.69		77
347	Hill, 1974	92	Chicken (*Gallus domesticus*)	2	U	FD	5	w	1	d	JV	B	MOR	MORT	WO	7.63		68
348	McGhee et al, 1965	14453	Chicken (*Gallus domesticus*)	5	U	FD	4	w	NR	NR	JV	NR	MOR	MORT	WO	8.14	16.3	84
349	Ko et al, 1985	2181	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	d	JV	M	MOR	MORT	WO	8.40		79
350	Skrivan et al, 2000	25969	Chicken (*Gallus domesticus*)	2	M	FD	38	d	1	d	JV	B	MOR	MORT	WO	9.72		74
351	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	11.7		68
352	Jenkins et al, 1970	2162	Chicken (*Gallus domesticus*)	2	M	FD	6	w	1	d	JV	B	MOR	MORT	WO	13.4		83
353	Marron et al, 2001	25968	Chicken (*Gallus domesticus*)	2	U	FD	21	d	7	d	JV	M	MOR	MORT	WO	14.2		78
354	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	5	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	14.3	28.7	83
355	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	14.3	28.7	83
356	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	14.3		77
357	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	2	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	14.3		77
358	Wood and Worden, 1973	36216	Duck (*Anas platyrhynchos*)	2	U	FD	16	d	2	d	JV	B	MOR	MORT	WO	18.1		77
359	Ward et al, 1995	6788	Turkey (*Melagris gallopavo*)	2	M	FD	10	d	5	d	JV	M	MOR	MORT	WO	18.3		84
360	Ankari et al, 1998	2006	Chicken (*Gallus domesticus*)	4	U	FD	84	d	25	w	SM	F	MOR	MORT	WO	19.9		73
361	Latymer and Coates, 1981	2191	Chicken (*Gallus domesticus*)	2	U	FD	24	d	1	d	JV	B	MOR	MORT	WO	21.3		69
362	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	336	d	17	w	SM	F	MOR	MORT	WO	21.6		79
363	Ward et al, 1995	6788	Turkey (*Melagris gallopavo*)	2	M	DR	10	d	5	d	JV	M	MOR	MORT	WO	26.6		79
364	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	28.7	57.4	83
365	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	5	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	28.7	57.4	83
366	Hill, 1974	1369	Chicken (*Gallus domesticus*)	2	U	FD	5	w	1	d	JV	M	MOR	MORT	WO	28.7		70
367	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	28.7		77
368	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	28.7		77
369	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	28.7		77
370	Poupoulis and Jensen, 1976	2250	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	NR	MOR	MORT	WO	28.7		77
371	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	MOR	MORT	WO	29.7		79
372	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	B	MOR	MORT	WO	29.7		79
373	Miles et al, 1998	2221	Chicken (*Gallus domesticus*)	4	U	FD	42	d	1	d	JV	B	MOR	MORT	WO	30.8		70
374	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	MOR	MORT	WO	31.6		79
375	Mehring and Brumbaugh, 1960	22	Chicken (*Gallus domesticus*)	5	M	FD	10	w	1	d	JV	B	MOR	MORT	WO	33	43.3	89
376	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	MOR	MORT	WO	35.2		79
377	Jackson and Stevenson, 1981	2158	Chicken (*Gallus domesticus*)	6	U	FD	280	d	18	w	SM	F	MOR	MORT	WO	35.4		79
378	Jackson et al, 1979	2160	Chicken (*Gallus domesticus*)	5	U	FD	232	d	17	w	SM	F	MOR	MORT	WO	35.5		79
379	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	MOR	MORT	WO	43.3		79
380	Waibel et al, 1964	14405	Turkey (*Melagris gallopavo*)	3	U	FD	3	w	7	d	JV	NR	MOR	SURV	WO	46.6		72
381	Christmas and Harms, 1979	2052	Turkey (*Melagris gallopavo*)	3	U	FD	21	d	1	d	JV	B	MOR	MORT	WO	48.3		79
382	Jackson and Stevenson, 1981	2159	Chicken (*Gallus domesticus*)	6	U	FD	336	d	26	w	SM	F	MOR	MORT	WO	50		79
383	Vohra and Kratzer, 1968	14404	Turkey (*Melagris gallopavo*)	5	U	FD	21	d	NR	NR	JV	B	MOR	MORT	WO	60.0	120	83
384	Jackson, 1977	2157	Chicken (*Gallus domesticus*)	6	U	FD	35	d	NR	NR	SM	F	MOR	MORT	WO	62.7		78
385	Hill, 1974	92	Chicken (*Gallus domesticus*)	6	U	FD	5	w	1	d	JV	F	MOR	MORT	WO	81.6	122	83
386	Hill, 1979	1370	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	B	MOR	MORT	WO	85.9		77
387	Jensen, 1975	1403	Chicken (*Gallus domesticus*)	2	U	FD	14	d	1	d	JV	NR	MOR	MORT	WO	92.9		79
388	Van Vleet et al, 1981	80	Duck (*Anas platyrhynchos*)	2	U	FD	15	d	1	d	JV	M	MOR	MORT	WO	201		77
389	Ko et al, 1985	2181	Chicken (*Gallus domesticus*)	4	U	FD	3	w	3	d	JV	M	MOR	MORT	WO		2.69	79
390	Foster, 1999	18769	Duck (*Anas platyrhynchos*)	2	M	DR	4	d	4	d	JV	NR	MOR	MORT	WO		78.5	77
391	Shivanandappa et al, 1983	3727	Chicken (*Gallus domesticus*)	6	U	OR	3	w	25	w	JV	M	MOR	MORT	WO		79.6	80

Appendix G-6 Ecological Benchmark Value (EBV) Calculations based on a Mortality Endpoint - Copper

Result Number	Reference	Ref. No.	Test Organism	Number Conc/ Doses	Method of Analysis	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
Survival (MOR)																		
392	Van Vleet et al, 1981	80	Duck (*Anas platyrhynchos*)	2	U	FD	15	d	1	d	JV	M	MOR	MORT	WO		201	77
393	Shivanandappa et al, 1983	3727	Chicken (*Gallus domesticus*)	5	U	OR	4	d	25	w	JV	M	MOR	MORT	WO		536	80

Studies with an exposure duration equal to or greater than 4 weeks (28 days)

Source

Ecological Soil Screening Levels for Copper. Table 5-1: Pg 15-16. Interim Final. OSWER Directive 9285.7-68. US Environmental Protection Agency. February 2007.

		NOAEL	LOAEL
All Studies	AVERAGE	33.41	105.51
	GEOMEAN	23.962591	55.79462
	COUNT	45	13
ED>=10 weeks	AVERAGE	33.52	43.30
	GEOMEAN	32.400346	43.3
	COUNT	10	1
ED>=10 weeks Bounded Value Only		33.0	43.3
	AVERAGE	26.84	50.54
ED>= 4 weeks	GEOMEAN	21.994481	42.08128
	COUNT	32	7